PHARMACOGRAPHIA INDICA.

HISTORY

OF THE PRINCIPAL DRUGS

OF VEGETABLE ORIGIN,

MET WITH IN

BRITISH INDIA.

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PREFACE.

THE available information concerning the drugs and medicinal plants of India is scattered through a number of books and periodicals in various languages, as well as official documents, which have only had a very limited circulation.

The authors of the work now presented to the public have endeavoured to collect and verify this information, and supplement it where deficient by original investigation especially directed towards the elucidation of the chemical composition and physiological action of the plants and drugs.

Plants of historical and mythological interest which have long been used in Indian medicine from superstitious reasons, though possessing little or no medicinal activity, have not been omitted, as the history of Indian medicaments would be incomplete without them. In compiling this portion of the work much interesting information has been derived from De Gubernatis' interesting work on Plant Mythology.

In 1883 one of us published a similar work treating of the medicinal plants of Western India and the drugs sold in Bombay, the great drug market of the East. Owing to the rapid increase in the study of organic chemistry during the last few years, much would now have to be added to that work to bring it up to date.

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PHARMACOGRAPHIA INDICA.

RANUNCULACEÆ.

ACONITUM FEROX, Wall.

Fig.—*Bentl. and Trim.* t. 5. Indian Aconite, Nepaul Aconite (*Eng.*), and one or more other species of poisonous aconite growing in Northern India.

Hab.—Temperate subalpine Himalaya, from Sikkim to Garhwal. The tuber.

Vernacular.—Bish or Bikh, derived from the Sanskrit Visha. Bachnág (*Hind.*), Bachnag (*Beng.*), Vashanavi (*Tam.*), Vasanabhi (*Tel. Can.*), from Sanskrit Vatsanabha. [illegible] vachnág (*Guz.*).

History, Uses, &c.—The aconite poison or drug is generally supposed to be derived from *A. ferox*, but we have no very exact information upon this point.

Aconitum luridum, *H. f.* and *T.* is found in Sikkim; *A. lycoctonum*, *Linn.*, from Kashmir to Kumaon; *A. Napellus*, *Linn.*, along the temperate alpine Himalaya in four varieties, *viz.*, proper, rigidum, multifidum, and rotundifolium. *A. palmatum*, *Don.*, in the Eastern temperate Himalaya from Garhwal to Manipur. The last species is considered by the natives of Sikkim not to be poisonous. (*Dr. G. King.*)

Hindu writers mention no less than eighteen kinds of Bish or poison, of which ten are said to be unfit for medicinal use on account of their extremely poisonous properties, which they exaggerate to such an extent as to say that their touch is fatal; of the eight kinds which may be used, that known as Teliya*

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* Teliya applied to drugs means that they have been greased or oiled to preserve them from the action of the air, *e.g.*, Teliya-tankankhár, Borax which has been greased to prevent efflorescence.

Bachnag is said to be the best; it is of a yellowish brown colour, and in shape like a deer's horn. Bish as a name for Aconite appears to have been known to the Hindus from the earliest ages, but the word appears to have been applied also to any very poisonous root. The nine virulent poisons mentioned by Sanskrit writers are certainly not all Aconites, as some of them are described as growing in parts of India in which Aconites are not found; thus it would appear that the Sanskrit Visha, and its equivalents, Bish and Bikh,* in the modern Indian languages, may be understood to mean poison, and especially Aconite as being the commonest poison known. The non-poisonous Aconites which are used as medicines, have distinct vernacular names. The author of the Makhzan-el-Adwiya and other Arabian and Persian writers describe Bish as an Indian drug, and appear to have copied their accounts of it from Hindu books; there is some difference of opinion as regards its properties, some considering it to be cold in the fourth degree, and others hot and dry; the latter opinion seems to prevail, as the drug is recommended in diseases arising from cold humours and atrabilis, and also in leprosy, cough, asthma and ulceration of the throat.† Bish is much used as an external application, the root being formed into a paste (*lep*) and spread upon the skin as a remedy for neuralgia and other painful affections, such as boils, &c.; internally it is prescribed in fever and rheumatism, but is generally mixed with a number of other drugs, both mineral and vegetable; moreover, it undergoes a process of purification by being boiled in milk or cow's urine, which must considerably diminish its activity. In native prescriptions for cough, asthma, and fevers Aconite is combined with borax and aromatics, sulphur and croton seeds are added if there is constipation. The famous Indian pill for snake-bite contains aconite root, white arsenic, yellow arsenic, red arsenic, herb of *Aristolochia*

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* In Northern India ष is pronounced kh, in Southern India sh.

† In Paris public singers employ with success the alcoolature d'aconit in doses of 10 to 20 drops in a glass of eau sucrée, of which a mouthful is taken occasionally to clear the voice.—(Dorvault.)

bracteata, fruit of *Randia dumetorum*, in equal parts. These drugs are rubbed down on a stone with the juice of the Betel pepper-leaf, and made into pills, the size of the seeds of *Abrus precatorius* (about 2 grs.). The dose is one pill every five minutes rubbed down with Betel-leaf juice until three pills have been taken. European physicians in India have long been in the habit of using Bish as a substitute for ordinary Aconite root, and it has of late years been used in Europe as a source of Aconitine. As far as our experience goes it is not more dangerous than the mixed roots known in the European markets as German Aconite; a supply of Aconite of known botanical origin is still a desideratum in pharmacy. Modern physiological research shows that Aconite applied locally acts as a local irritant and narcotic, producing numbness and tingling. Introduced into the circulation in large quantity it causes sudden paralysis of the heart muscle, which appears to be due to the action of the poison upon the vagus roots; smaller, but poisonous doses, cause disturbance of the respiration, muscular weakness, vascular depression, and death. Therapeutic doses cause reduction of the force and frequency of the circulation, muscular inertia, and slight tingling in the extremities or lips. Similar effects are produced in man and in animals. Numerous experiments have been made to ascertain the manner in which Aconite influences the heart, but further investigation is still required to settle this point. Aconite may be used to lower arterial action and with it excess of temperature in fevers of a sthenic type, to relieve over-excitation of the sensitive nerves, as in neuralgia or rheumatism. It must be borne in mind that its influence upon the motor centres and nerves is much less than upon the sensitive centres and nerves and upon the heart. Atropine and Digitalis have been used with success in cases of poisoning by aconite; they appear to restore the power of the heart by counteracting the effects of the poison upon the vagus roots.

Description.—The fresh root of *A. ferox* has been described by Balfour (*Edinb. New Phil. Journ.*, xlvii., 1849), from

a plant growing in the Edinburgh Botanical Gardens, as having 2-3 fasciculated, fusiform attenuated tubers, some nearly five inches long and 1½ inch in circumference, dark brown externally, white within, sending off sparse long, rough branching fibres. Two kinds of the dried root (Bichnág) are met with in the Indian market. That in general use consists of black, plump heavy conical tubers, many of them four inches long, having a strong disagreeable smell like Hyraceum, and a reddish brown resinous fracture in dry weather; in the rainy season they become tough, horny and moist, and stain the fingers brown when handled. This kind, even when carefully washed, retains its strong smell which renders it unfit for medicinal use in Europe. It appears to be the *Nepal Aconite* of the books. The other kind, called White Bachnág, exactly corresponds with the description of the Bish imported into England as given in the Pharmacographia. It may have a horny or starchy fracture; in the former case it is more or less shrivelled, from having been exposed to heat, and the starch granules, if examined, will be found altered.

Microscopic structure.—If we examine a transverse section of a tuber which has not been subjected to heat, commencing from the circumference, we see an external brown epidermis composed of compressed cells, among which are some stone cells; next we come to a homogeneous white or yellowish starchy parenchyme, and at a certain distance from the circumference five to six or seven brown vascular bundles, connected together by a brown line composed of a zone of small stone cells; inside this we meet again with a starchy parenchyme, the centre of the tuber is often fissured. In young roots the vascular bundles are nearer the centre than in old ones.

Chemical composition.—For a full account of this, consult *Pharmacographia*, p. 9; *Dragendorff, Beiträge zur gerichtl. Chem.*, p. 57-72; *Flückiger, Archiv f. Pharm. B.* 191, p. 196; *Groves, Phar. Jour. and Trans.* 1873-74, p. 293; *Report on Aconite Alkaloids, by Dr. Alder Wright, Year-Book of Pharm.*, 1881, p. 27; *Dragendorff, Analyse chimique de quelques drogues*

actives, traduit par. Morel, p. 13. The following extracts are made from the last-named work:—.

"The tubers known as Bish, which have for some time been met with in commerce, contain an alkaloid, which, in its chemical reactions, presents a close analogy with aconitine. I find that the alkaloid of Bish, which has been called nepaline and pseudo-aconitine, can be quantitatively determined by the same process as aconitine, and that it gives the same reactions as that alkaloid. I may mention as a distinguishing character of this alkaloid, its greater solubility in boiling water and its being less soluble in ether and chloroform. I may, perhaps, also mention that unlike the aconitine of Duquesnel, nepaline prepared by the same process is not precipitated by chloride of platinum. Nepaline can be estimated by means of Mayer's solution, one c.c. corresponding to 0·0388 grammes of the alkaloid; I have obtained from farinaceous Bish extracted by water 1·81 and 1·82 per cent. and extracted by alcohol 1·45 and 1.04 per cent. of nepaline. If the action of the alcohol is prolonged for several days, a better result is obtained."

One litre of Mayer's solutions contains 13·546 grm. of perchloride of mercury and 49·8 of iodide of potassium. Its action is based upon the formation of a double iodide of the alkaloid very sparingly soluble in water, and composed of 1 eq. of iodide of aconitine and 1 eq. of biniodide of mercury.

According to Wright and Luff, the formula for aconitine is $C^{33} H^{43} NO^{12}$, and for pseudo-aconitine $C^{36} H^{49} NO^{12}$.

F. Mandelin (*Archiv. der Pharm., February and March*, 1885,) gives the following as the conclusions he arrives at after a thorough investigation of the subject of aconitine:—

1. Japaconitine is identical with aconitine, and both are identical with a crystalline benzoylaconine.

2. Benzoylaconine is the only active principle of *Aconitum Napellus*, the other alkaloids contained in the plant being amorphous and pharmacologically unimportant.

3. The active principle of the roots of *Aconitum ferox* is however pseudo-aconitine or veratroylaconine.

4. Aconitine and pseudo-aconitine are pharmacologically identical, but in consequence of its molecules being larger, more veratroylaconine is required to produce the same effects as aconitine.

5. The difference in the toxicological effects of *Aconitum Napellus* and *Aconitum ferox* depends entirely upon the relative amount of aconitine contained in the two plants respectively, and not, as hitherto supposed, upon any difference in the virulence of the active principle of either of them.

6. Aconitine and pseudo-aconitine are the strongest known poisons.

7. The maximum dose to be given at one time would be 0·1 m. g. or 0·5 m. g. per diem. Subcutaneously the dose should be less.

8. Aconine ($C^{26}H^{41}NO^{11}$) and pseudo-aconine, which are probably either identical or homologous, are likewise poisonous, but far less so than their mother alkaloid.

9. Benzoylaconine and veratroylaconine show an interesting chemical and pharmacological analogy to the alkaloids of the atropine group.

10. The aconitine of commerce is either benzoylaconine or veratroylaconine in a greater or less degree of purity; the German and French preparations being benzoylaconine, the English (especially Morson's) veratroylaconine.

11. The cause of the difference in the physiological effects of the various aconitines of commerce depends chiefly upon the relative amount of alkaloidal products of decomposition (aconine or pseudo-aconine) which they contain, and which do not occur only as such, but also in the form of intermediate products of decomposition of aconitine (amorphous alkaloids).

12. Pure aconitine should yield a *colourless* solution with concentrated sulphuric acid, should not turn red on the addition of one or two drops of a concentrated solution of sugar;

the yellow precipitate, formed by adding phosphomolybdic acid to solutions of aconitine, should dissolve in a few drops of ammonia without any blue coloration.

13. Pure aconitine yields no colour reactions, and those formerly suggested were due to impurities.

14. Hübschmann's napelline is no distinct alkaloid, but a variable mixture of aconitine and aconine.

15. Acolyctine and lycoctonine are not identical with aconine (pseudo-aconine). (*See chemical comp. of A. Lycoctonum.*)

16. Aconitine and pseudo-aconitine do not split up in the animal organism, absorption and ejection taking place very quickly.

17. Owing to its virulence, its ready decomposition, and the absence of delicate characteristic tests, the *post-mortem* detection of aconitine as such is very difficult, the symptoms and the condition of the internal organs are chiefly to be relied upon.

Toxicology.—Chevers, on the authority of Wallich, mentions that the Burmese, during their retreat before the British, threw bruised aconite root into a water tank in the hope of poisoning the troops pursuing them. The Aka hill tribes on the frontier of Assam make use of a paste made of Aconite root to poison their arrows. Some of these arrows and the root from which the poison was reported to be obtained were forwarded to the Chemical Analyser, Bengal, in 1881, for examination. Some of the arrowheads were made of iron, others of bamboo; they were covered with a dark brown adhesive mass which gave the flat heads an oval contour, and this material was applied for a distance of nearly two inches down the shaft below the barb. The adhesive material proved to be aconite, and the root stated to be the source of the poison was also aconite, but the species could not to be determined. The coarsely powdered root rubbed up with water formed an adhesive mucilaginous mass in every way like the material found on the arrow heads. It would thus appear that the root contains sufficient intrinsic gummy material to make a paste on being rubbed up with

water (*Rep. Chem. Exam., Bengal, for* 1886.) About the same time that the arrow-heads were being examined, the Chemical Analyser received from Dr. G Watt a small cane basket, labelled *Mya-mishmi-baibik*, which had been purchased from the Mishmis. The basket contained 130 grms. of what proved to be small aconite roots, which varied in weight from 1·2 grms. to ·5 grms. The species could not be identified. On analysis, the following results were obtained:—

Moisture at 100° C.	18·26	per cent.
Alcoholic extract of anhydrous roots ...	17·91	,,
Fatty matter of do. ...	0·955	,,
Chloroform extract of do. ...	0·885	,,
Crude aconitine	0·887	,,
Aconitine by Meyer's reagent	0·777	,,

The pounded root when mixed with water formed a sticky mass well adapted for smearing over arrow heads, for which purpose it is stated to be employed. (*Rep. Chem. Exam. for Bengal*, 1885.)

Cases of accidental poisoning by aconite are occasionally met with arising from the use of the drug by ignorant native doctors as a remedy for fever, &c. Homicidal and suicidal cases are occasionally reported, but are not so frequent as one might expect, considering how readily the drug can be obtained, and how well known are its poisonous properties. Chevers, for example, states that during the ten years ending 1869, only thirty-six cases of aconite poisoning came under the notice of the Bengal Chemical Examiner; and Burton Brown records only nineteen cases in the Punjab in the years 1861—73. The Bengal Chemical Examiner states that the average of five years previous to 1881—82 was 2·4 per cent. in the viscera examined in Bengal. In the same province the number of cases of aconite poisoning were in 1881—82, 3·1 per cent. in 225 viscera examined. In 1882—83, 2·0 in 210; in the remaining nine months of 1883 *nil* in 127; in 1884, 1·8 in 217; in 1885, 1·7 in 234; in 1886, 0·37 in 266; and in 1887, 0·42 in 233.

As regards the percentage of aconite detection in articles suspected to be poisons, the following are the Chemical Analyser's figures for Bengal:—

Average of six years ending March 31st 1883	2·82
Nine months of 1883	2·20
1884	2·10
1885	1·50
1886	3·10
1887	1·10

As a cattle poison aconite is rarely used in Bengal. In Madras aconite was only found in cases in Class A, *i.e.*, human cases in which it was suspected that poison had been administered, and in which one or more of the following, *viz.*, viscera, vomited matters and food were forwarded for examination:—

Year	No. of cases examined	Aconite detected
1882	152	4
1883	123	2
1884	85	1
1885	81	1
1886	84	0
1887	76	1

No aconite detections are recorded in Class B, *viz.*, food and other articles suspected to be poisons.

In Bombay two detections of aconite were made in 1879-80, one in human viscera, and the other in food, the total number of examinations made in the same year being 105. In 1881, two detections were made in a total of 83 examinations, one in human viscera and the other in liquor. Dr. Lyon remarks that aconite (like datura) appears to be occasionally used by native liquor dealers for the purpose of conferring additional intoxicating power on alcoholic liquors, sometimes with fatal result. The Bombay Analyser's reports for ten years ending 1884 show only six cases of aconite poisoning, three of which were accidental.

In the Punjab Dr. Center reports that aconite is not often used as a poison. The returns show the following percentages: 1879, 1·8 detections in 162 examinations; 1880, 0·5 in 194; 1881, *nil* in 186, 1882, 1·9 in 201, 1883, *nil* in 191; 1884, *nil* in 200, 1885, *nil* in 231; 1886, 0·35 in 272; 1887, *nil* in 228.

In the North-West Provinces and Oudh four detections of aconite were made in a total of 156 examinations in 1879, and in 1882 three in a total of 156. In the other years, from 1879 to 1887, no detections were made. These figures cannot be compared with those from other Provinces, as no distinction is made between human viscera examined and substances suspected to be poisonous. The aconite root usually sold in the plains of India is ill-suited for homicidal purposes on account of its strong hyraceum-like odour and dark colour. It is probable that in Eastern Bengal aconite root in its natural condition is more easily obtainable than in other parts of the country. The strong smelling aconite appears to be used chiefly for poisoning tigers and other beasts of prey. Aconite has been detected in cattle poisoning, but its use is extremely rare.

Commerce.—Aconite root (Bachnág) is imported into Calcutta and other Indian markets chiefly from Nipal; the black strong smelling kind is almost exclusively used in this country. Its average price is 9—10 annas a pound. Other Vernacular names for it are Mithabish, Sringibish, and Dagra.

White Bachnág can be obtained for the same price from Calcutta. It appears to have been brought into commerce for export to Europe.

In the Southern Concan *Lagenandra toxicaria* is known as Vatsanábh.

Some parcels of Aconite root met with in the Indian markets are composed of much smaller tubers than those usually seen, and are evidently obtained from a different plant than *A.*

ferox, probably from *A. Napellus**; they have the usual strong hyraceum odour. In Madras it is sometimes mixed with the roots of *Gloriosa superba*.

ACONITUM LYCOCTONUM, *Lin.*

Fig.—*Jacq. Aust.* 4, t. 380. *Royle Ill.* 56. *A. luc.*

Hab.—West temperate Himalaya, Kumaon to Kashmir, Europe, N. Asia. The tubers.

Vernacular.—Khánik-et-zeib (*Arab.*), Bikh (*Hind.*)

History, Uses, &c.—An Aconite called τὸ λυκοκτονον is mentioned by Galen λυκοκτόνος, or the wolf-slayer, was a name given to Apollo, the God who averts evil. Aconite was used by the ancients to destroy wild beasts. Amongst the latter Greeks, Apollo was the Sun-God; for these reasons, possibly, the yellow aconite has been named Lycoctonon.

In 1865, Hübschmann announced that he had discovered in the root and rhizome of *Aconitum Lycoctonum* two new alkaloids, which he named lycoctonine and acolyctine; they differed from one another notably in their solubility in ether and water, lycoctonine being soluble in ether but only sparingly in water, whilst acolyctine was insoluble in ether, but dissolved by water. Hübschmann, however, subsequently stated that acolyctine was probably identical with the napelline he had obtained from *A. Napellus*. Lycoctonine has been examined chemically by Flückiger and by Dragendorff, whilst physiological experiments by Klebs showed that it was much less powerful in its action than aconitine. Schroff, jun., found that different samples of napelline (acolyctine) of commerce varied both in their chemical

* The Aconite of the Greeks and Romans, the ἀκόνιτον ἕτερον of Dioscorides is generally considered to be *A. Napellus*, Khanik-el-zeib and Khánik-el nemir (wolf strangle, and panther strangle) are Arabic names for poisonous Aconites. Ibn Sina says in the Kanun that they kill wild pigs, dogs, tigers and panthers, and are not used medicinally. (*Conf. Dioscorides* iv. 76; *Plin.* 27, 2; *Theophr. H. P. IX*, 16, 17

reactions and in the degree of physiological effect they were capable of producing, lycoctonine was less active. He also pointed out the fact that the presence of these two alkaloids was an insufficient explanation of the powerful toxic action which the root of *A. Lycoctonum* possessed, and thus threw a doubt on their being the only active principles contained in it. In all these physiological experiments, as well as others by Schroff, sen., Buchheim, Eisenmenger, and Ott, the identity of napelline with acolyctine has been assumed: no trial was made with acolyctine prepared from *A. Lycoctonum*. To throw more light upon these matters (*see also Chemistry of A. ferox*), Messrs. Dragendorff and Spohn (*Pharm. Zeitsch. fur Russland* xxiii., 313–381), investigated the roots of *A. Lycoctonum* collected in Switzerland in July 1883.

Isolation of the Alkaloids.—The method adopted by the authors was Duquesnel's modified as follows:—

Two kilos of the powdered root were mixed with tartaric acid (successive portions of 10 and 5 grams) and exhausted with strong spirit; for this, three macerations sufficed. The tincture was concentrated, mixed with water, filtered, and repeatedly agitated with ether whilst still acid. The ether removed traces of an acid resembling protocatechuic, but benzoic acid could not be detected. None of the acid decomposition-products of the alkaloids presently to be described could be found, a proof that a suitable method of extraction had been adopted.

The liquid, after exhaustion by ether, was made alkaline with bicarbonate of soda, and again agitated with ether, which now removed a quantity of alkaloid. After exhaustion with ether, chloroform extracted a further portion of alkaloid from the alkaline liquid, in which, after this treatment, only traces of alkaloid could be detected.

The ethereal solutions were evaporated to dryness and the alkaloid in which Hubschmann's lycoctonine was anticipated, was purified by powdering, digesting with ether, evaporating the ethereal solution, and repeating the treatment until the

alkaloid dissolved easily and completely in the ether. It was finally obtained in the form of a pale yellow resinous mass, yielding a white powder and dissolving completely in dilute acids. No attempt to crystallize it was successful.

The alkaloid dissolved by chloroform was purified by similar treatment with ether, which solvent removed a notable quantity of the first alkaloid. After purification by solution and treatment with animal charcoal, the second alkaloid was obtained in the form of a white or pale reddish powder. Fifteen kilos of the dry root yielded 170 grams (1·13 per cent.) of alkaloid soluble in ether, and 120 grams (0·8 per cent.) of alkaloid soluble in chloroform.

Alkaloid soluble in ether.—In this lycoctonine was anticipated, but it was found on examination to differ materially from that alkaloid, especially in being non-crystallizable. As it could not be identified with any known alkaloid, the name of lycaconitine was proposed for it.

Ultimate analysis showed the probable formula to be $C^{27}H^{34}N^2O^6+2H^2O$, the two molecules of water being given off at a temperature of 110° C., at which, however, the alkaloid itself undergoes change. The accuracy of the formula was confirmed by the examination of the salts as well as of the platinum and gold compounds. The latter, and, indeed, the double salts generally, are unstable, suffering partial decomposition when washed with water.

None of the salts could be crystallized, but as they are easily diffusible, they are probably crystallizable.

A ten per cent. solution of lycaconitine in absolute alcohol is dextro-rotatory $(\alpha)_D = +31·5°$. After drying in vacuo, lycaconitine begins to melt at 111·7°, and is completely fused at 114·8° (corr.); the alkaloid undergoes, as previously observed, partial decomposition.

The reactions of lycaconitine show but little that is characteristic. With sulphuric acid it gives a reddish-brown solution; sulphoselenic acid is coloured rose or pale reddish-

violet; this reaction is not exhibited by aconitine, nepaline, or commercial lycoctonine. Syrupy phosphoric acid yields, with lycaconitine, a violet solution when warmed. Lycaconitine is incompletely precipitated by caustic potash, ammonia, and alkaline carbonates; strong alkalies partially decompose it.

The foregoing details suffice to show that lycaconitine is not identical with Hubschmann's lycoctonine or acolyctine, nor with aconitine or nepaline, or indeed with any known alkaloid.

Alkaloid sparingly soluble in ether.—This alkaloid, extracted with chloroform, after the separation of the lycaconitine by ether, differs so strikingly from Hubschmann's acolyctine that the possibility of identity appears to be excluded. It was named myoctonine, in reference to a species of aconite, myoctonon, mentioned by Pliny. It is amorphous, and the salts it forms could not be crystallized. Analysis showed the formula of the alkaloid after drying over sulphuric acid to be $C^{27} H^{30} N^{2} O^{8}$, and the correctness of this formula was confirmed by an examination of the salts. Bisulphide of carbon, absolute alcohol, benzol, and chloroform dissolve the alkaloid in almost any proportion. The taste is bitter, not pungent. It is dextro-rotatory; melts at 143° to 144°, and gives a precipitate with alkaloid group-reagents, but yields no characteristic colour reactions.

Warmed with 1 per cent. solution of caustic soda, myoctonine decomposes, like lycaconitine, into lycoctonine, lycoctonic acid, an alkaloid resembling acolyctine, and a fourth body the nature of which could not be ascertained. From this it is evident that the long-continued heating with carbonate of soda, to which Hubschmann subjected the alkaloids originally present in the root, converted them into lycoctonine and lycoctonic acid; one or other of these then probably yields acolyctine by further decomposition. Physiological experiments with lycaconitine and myoctonine conducted by M. Salmonowitz showed the latter to be a powerful poison resembling curare in its action, and acting most energetically when introduced directly into the circulation. The sub-

cutaneous injection of 0·075 gram. of nitrate into a cat produced distinct toxic symptoms, and the injection of 0·1 gram. was always followed by death in twenty to thirty minutes. Mice were killed by one milligram in three minutes. Lycoctonine and lycaconine, the decomposition-products of lycaconitine and myoctonine respectively, were found to resemble the original alkaloids in their physiological action, but to be less powerful. (*Year-Book of Pharm.*, 1885.)

ACONITUM HETEROPHYLLUM, *Wall.*

Fig.—*Bentl. and Trim., t.* 7.

Hab.—West temperate Himalaya from Kumaon to Hansora. The tubers.

Vernacular.—Atís (*Hind.*), Atavish (*Mar.*), Ati-vadayam (*Tam.*), Ati-vasa (*Tel.*), Atavakha-ni-Kali (*Guz.*).

History, Uses, &c.—The earliest notices of Ativisha* are to be found in Hindu works on Materia Medica, Sárangadhara and Chakradatta, where it is recommended as a remedy in fevers, diarrhœa, dyspepsia and cough, also as an alexipharmic; those in Arabic and Persian works are short, and apparently copied from them; they direct it to be prescribed in combination with aromatics, astringents and sometimes with other bitters, such as Bonduc-nuts, Tinospora, Holarrhena, &c. It is an ingredient in *Bál-goli*, a pill given to infants to keep them quiet, which contains thirty-one drugs, of which *three are narcotics, viz.*, Bhang, Opium and Datura, and the remainder bitters and aromatics. This pill is sold by all the native druggists, and, it need hardly be said, is most fatal to children. The author of the Makhzan-el-Adwiya calls Atis an Indian root, resembling a small specimen of *Aristolochia longa*, and says that some authorities describe three kinds, *viz.*, Atís, Part-bikhta, and Shánkand; but others only two kinds—white and black. He says it is aphrodisiacal and tonic, checks

* Ati-visha, counteracting poison.

diarrhœa, and removes corrupt bile and cold humours and the diseases arising from them.

The early English physicians in India appear to have been chiefly impressed with its antiperiodic and tonic action in fevers, and the drug has until quite a recent date been much administered as an antiperiodic in doses of about 30 grains every four or six hours. The discovery that the active principle, Atisine, is only present in very small quantities in Atís, seems to have brought the drug into discredit, and the European demand for it has much fallen off. The evidence collected by Dr. G. Watt for his Dictionary of the Economic Products of India indicates that Atís is now considered an indifferent antiperiodic by medical men. Dr. M. Sheriff considers that the ordinary doses are only useful as a tonic, and that two drams or more should be given as an antiperiodic. Probably the native estimate of the drug, as given above from the Makhzan, is not far from the truth, *viz.*, that it is tonic and digestive and often useful in dyspepsia with diarrhœa.

Description.—The drug, as sent into commerce, may be divided into two portions, grey and white; the grey shrivelled tubers, which are larger and longer than the white, are the mother roots, and are often separated and sold at a lower price. The young daughter-tubers should be quite plump, externally of a pale ash colour, slightly scarred from the abrasion of rootlets, from ¼ to 2 inches long, obconical, or almost ovoid, with a thin tap-like extremity, which is sometimes double, or has a tendency to divide; at the summit there is a scaly leaf-bud. Atís should break with a short starchy fracture, presenting a white surface, near the circumference of which several vascular bundles are observable with the naked eye; it should taste purely bitter, and have no particular odour.

Microscopic structure.—The tubers consist of a delicate cellular parenchyme filled with starch, in which are to be observed about four vascular bundles, which, in the young tuber, are near the centre, but subsequently are removed towards the circumference. The epidermis consists of light

brown tabular cells; the brown zone seen in Aconite is not present.

Chemical composition.—The authors of the Pharmaeographia, upon the authority of Broughton, state that the root contains a well-defined alkaloid of intensely bitter taste, Formula $C^{16} H^{74} N^2 O^5$ obtained from concurrent analyses of a platinum salt. Wright (1878) percolated the powdered dry root with alcohol containing a little tartaric acid; and evaporating the percolate he obtained ultimately Broughton's alkaloid *atisine*. This was uncrystallizable, but with hydrochloric acid and gold chloride, he obtained a crystalline hydrodichloride, $C^{22} H^{31} NO^2 HCl, AuCl^3$, from which he suggests that $C^{22} H^{31} NO^2$ may prove nearer the correct formula for atisine than that given by Broughton. Atís has recently (1879) been examined chemically by Wasowicz. The general results of his investigation are: that he found the root to contain—(1) a fat of soft consistence, probably a mixture of oleic, palmitic, and stearic glycerides; (2) aconitic acid; (3) an acid related to ordinary tannic acid; (4) cane-sugar; (5) vegetable mucilage; (6) pectous substances; (7) atisine, the alkaloid already observed by Broughton, and probably another uncrystallizable alkaloid; (8) starch. The root contained 2·331 per cent. of ash that dissolved partly in water and partially in dilute hydrochloric acid. Experiments made in administering the alkaloid to rabbits show that it is not poisonous. The quantity in the root is exceedingly small ($\frac{8}{100}$ of 1 per cent.). The purified alkaloid is white and uncrystallizable; of its salts, only the hydrochlorate, hydrobromate and hydriodate are crystallizable. (*Archiv. der Pharmacie*, Vol. XI., p. 19.) Atisine when dissolved in sulphuric acid gives a purple colour, a reaction which has been observed by E. Z. Gross with coptine obtained from *Coptis trifoliata*; and with hydrastine, one of the alkaloids of *Hydrastis canadensis*, plants belonging to the same natural order.

Commerce.—Atís comes into the plains through the principal towns of Northern India; it would appear that in some parts

of Southern India other roots are sold as Atís. (*Pharmacographia*, p. 15.*) The average price is Rupee ¾ to 1 per lb.

ACONITUM PALMATUM, *Don.*

Hab.—Temperate Himalaya from Sikkim to Garhwal, Mishmi. The tubers.

Vernacular.—Bikhma, Bishma (*Hind.*), Wakhma or Vakhma (*Bomb.*).

History, Uses, &c.—It is impossible to trace the history of this drug in Indian and Persian works on Materia Medica, though doubtless it is one of their non-poisonous kinds of Bish. The author of the Makhzan-el-Adwiya notices it as a non-poisonous kind of Bish, and says it may be prescribed in the same manner as Atís. In English works upon Indian drugs, it appears to have almost escaped attention. Dr. Buchanan, in his account of the Kingdom of Nepal, enumerates four kinds of Bikh, of which Bikhma is one; he describes it as a powerful bitter: it is a rare drug in most parts of the country. Bikhma is intensely bitter, like quinine, and is administered by Native doctors in combination with black pepper, or mace, in doses of about eight grains, as a remedy for pains in the bowels, diarrhœa, and vomiting; also to destroy intestinal worms and to remove costiveness. Externally it is applied in rheumatism. From its sensible properties we may conclude that it would be likely to prove a valuable tonic and digestive; but unless it is much more powerful than Atís, its high price and rarity will prevent its general use.

Description.—Tuberous roots of a light brown colour, 2 to 4 inches long, much resembling some samples of horny and farinaceous Bish in structure, *but differing from them in being*

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* The rhizome of *Cryptocoryne spiralis*, which has lately attracted attention by being offered for sale in London as a kind of Ipecacuanha, is the root referred to; it is known in Madras as Náttu-ati-vadayam or country-atís. (*Lawson.*)

branched. The tubers break with a short fracture, and the inner substance is either white and farinaceous, or horny and yellowish; both kinds of tuber have a pure persistent bitter taste and no acridity; the horny tubers when moistened develop a pungent smell like nasturtium.

Microscopic Structure.—The tuber is composed of a starchy parenchyme, with from 6—12 bundles of scalariform vessels; in young roots these are crowded together towards the centre, but in more mature ones they are nearer the circumference; there is no brown zone connecting the vascular bundles.

Chemical composition.—Bikhma has been examined in Prof. Fluckiger's laboratory by Mr. Yunichiro Shimoyama, who reports as follows:—"Ten parts of the powdered tubers with one part of slaked lime and about 100 parts of water were dried. The dried powder was repeatedly extracted by a sufficient quantity of strong alcohol, and the latter removed by distillation, to the residue a little acetic acid and water was added to get rid of resinous matters. The filtrate was further purified by means of ether, and the alkaloid precipitated from the acetic solution by adding caustic lye. By repeating the same treatment the alkaloid was at last obtained as a perfectly white amorphous powder of decidedly alkaline reaction, and a very persistent purely bitter taste The alkaloid dissolved in excess of hydrochloric acid, yielded needle-shaped crystals of the hydrochlorate, which were not produced when a neutral solution was used. The hydriodate was also found to be crystallizable, but not the picrate, chromate, or iodohydrargyrate. The aqueous solutions of the alkaloid were precipitated by bichloride of mercury and by tannic acid, not by iodide of potassium. The alkaloid was found to be readily soluble in alcohol, chloroform, bisulphide of carbon, benzol and ether, but none of these solutions afforded crystals; it was dissolved by concentrated sulphuric acid, and the yellowish solution gradually assumed a splendid purple colour, lasting for a day or more; it turned violet on addition of a few drops of water. If the alkaloid is evaporated at 100° C. with phosphoric acid, a fine violet hue is also produced."

Prof. Flückiger remarks:—"The alkaloid which Wasowicz extracted from *A. heterophyllum* in my laboratory is the same as that yielded by the Wakhma tubers."

Commerce—Bikhma is brought in small parcels to the Indian cities by religious mendicants. Value Rs. 2 to Rs. 6 per lb. according to the quantity in the market.

JADWAR.

The great purifier, or antidote. Arabic form of the Persian Zadwár زدوار quasi زداى وار In Ætius the Greek form is ζέδοαρ and Myrepsus writes τζετούαριον The Persian plant is also called Mah-parwin (Moon and Pleiades), probably because it blossoms in the beginning of summer when the Pleiades rise. Macer calls it Zedoar,—

> "Adpotmè sumptis zedoar obstare venenis
> Affirmant."

History, Uses, &c.—The history of this drug is beset with many difficulties, on account of the vague meaning of the term Jadwár; the name by which it is generally known, and which appears properly to mean the great antidote. Under Jadwár, the author of the Makhzan-el-Adwiya gives Antila as the Arabic name, and Sáturyús* as the Greek. Speaking of Bísh he says that the Hindus suppose that the only plant which can grow near it is the Jadwar, which is an antidote to it, and that they also affirm that there is a kind of rat, called 'Bish mush bisha,' which lives upon Jadwár, and is an antidote to Bish; this is the Búka Bish Mush of Ibn Sina.

* Dioscorides describes two kinds of σατύριον (III 134-135), both reputed to be aphrodisiacal; see also Pliny on Satyrion (26, 62, 63). Apuleius Platonicus says of Satyrion · Alii cinos, alii panion, Galli vis, a Græcis satyrion, alii enuaticon, alli serpinon, Itali priapiscum, Ægyptus orcisalitexiou, alii eriton, alii mene, alii torminalis. Neophytus speaks of ἀντουρα as an antidote; speaking of Zedoar he says ἔοικε δὲ ξηρῷ καὶ μέλανι μικρῷ καστάνῳ. (It is like a small, dry, black chestnut.) Barbosa mentions Zedoaria and Zerumbam as two distinct drugs on sale at Cannanore. (Cf. *Salmasius de Homon. sub voce Gedwar.*)

The Indian name Nirbishi he explains incorrectly as Nir, the antidote to Bish, the poison*; he describes five kinds:—

"*1st*—Khatai, black externally, purplish brown internally, scorpioid, knotted, tasting sweetish at first, afterwards very bitter.

2nd—Outside and inside brown, or yellowish brown.

3rd—Outside and inside black; when rubbed down it has a purplish tinge, bitter. This and the second kind come from Thibet, Nipál, Morang and Rangpore. (These three kinds are probably the roots of some kind of Aconite or Delphinium.)

4th—Blackish, bitter, size of an olive, comes from the Deccan hills, probably the tuber of a Curcuma. (The Gedwar figured in Clusius' Exotica, p. 378, appears to be of this kind.)

5th—Spanish, called Antila, black, soft, very bitter (ἀντουμα probably *Aconitum Anthora*)."

Of these, the first kind is said to be most esteemed. It would appear, then, that the term Jadwár has at different times been applied to various tuberous roots supposed to have alexipharmic properties, and that in India it is now applied to the root of a Delphinium or Aconite, at present known to the Hindus as Nirbishi, a term which, like Jadwár, has at different times been applied to very different plants. Royle tells us that the best Nirbisi is brought down from Bissehar and Amritsar, and is fusiform, and resembles Bikh; when cut it is of a brownish colour and slightly bitter and acrid. Aitchison says that *Jadwar-i-Khatai* is the name in Leh for the root of an Aconite imported from Nipal *via* Lhassa. It is called in the Punjaub *Nirbisi*, by Bhoteas in Leh *Bonga*, and by the Yarkandis *Farfi*; it is poisonous, and is administered in cases of poisoning and in severe illness, such as cholera, and is carried as a talisman about the person. Ulasr Muharrir says

* Nirvisha is a Sanskrit adjective meaning "not poisonous," and nirvishâ or nirvishi is never applied to aconite by medical writers, but denotes a peculiar grass, used as an antidote to certain poisons, namely, *Kyllingia monocephala, Linn.*—(*Dr. Rice.*)

that false Jadwár is prepared by boiling the roots of some of the milder kinds of Bish in milk, and colouring them; it is to be distinguished from genuine by its parting with its colour when dipped in warm water and wiped with a cloth; it has also a *shrivelled appearance, and the central portion to which the colour has not penetrated is pale; instead of being* intensely bitter, it is slightly acrid.

Native medical works abound in absurd stories concerning this article, and its wonderful power as a tonic and alexipharmic; it fetches a high price, and is generally kept in metallic mercury to prevent its being injured by insects; sometimes it is preserved in oil.

Jadwar appears to resemble much the Tienhiung of the Chinese, which is said by Dr. Porter Smith to be derived from *Aconitum variegatum.* Like Jadwár, this drug is blackish-brown internally, and more or less moist, having evidently undergone some kind of preparation. Dr. Morrison, Medical Officer to H. M.'s Consul at *Newchwang in Manchuria, mentions in a recent Consular report that Manchuria exported in 1884, 13,866* lbs of the roots of *Aconitum Anthora, barbatum,* and *Fischeri* (?) for use in medicine on account of their stimulant, diuretic and alterative properties.

Description.—What is considered now to be genuine Jadwár in India consists of small blackish-brown tubers, some irregularly ovoid, some conical, seldom more than one inch long and half an inch in diameter; they are somewhat wrinkled, and bear a few horn-like projections, which are the remains of rootlets; at the crown there is a scaly leaf bud. When in good condition the tubers are softish, and cut like a piece of dry liquorice extract, the colour being a uniform dark brown throughout; to the naked eye the cut surface appears structureless, and might be mistaken for an extract; it has a somowhat fruity smell and bitter taste.

Microscopic structure.—A transverse section shows a dark brown epidermis, composed of compressed cells, an outer ring of parenchyme, the cells of which contain starch granules and

much brown granular matter; within this are from 5 to 10 vascular bundles, connected together by a cambial zone, made up of several rows of small, dark brown cells; the position of the bundles is very irregular, consequently the zone has a peculiar waving course. *In the central portion of the tuber* starchy parenchyme is again met with; the starch has not been altered by heat.

Chemical composition.—Twelve ounces of the roots treated by Dragendorff's process for aconitine, yielded no trace of alkaloid upon evaporation of the benzine solution. The treatment of the drug by acidulated water extracted a large quantity of black extractive which was almost entirely soluble in alcohol. It seems probable that the roots undergo some form of preparation during which they are charged with foreign extractive matters, and probably rendered almost inert as a medicine.

Commerce.—Jadwar is brought for sale to the Indian cities in small parcels by religious mendicants.

DELPHINIUM ZALIL, *Aitch. et Hemsley.*

Fig.—*Trans. Linn. Soc. Ser. 2. Bot. Vol* iii., *Pl.* 3.

Hab.—The Badghis and Khorasan. The herb.

Vernacular.—Zarir (*Arab.*), Zalil, Asfrak, Asperag (*Pers.*), Tráyamán, Gul-jalil (*Bomb.*), Gáfiz, (*Punj.*).

History, Uses, &c.—In Hindu medical works a drug called Tráyamána is frequently mentioned as a remedy for enlargement of the abdominal viscera; it appears to have been well-known, as it has numerous synonyms such as Baládeva, Balábhadra, Mangalya, Mángalyarha, and Arjaka, signifying that it was considered to be very auspicious.* The same name is still current in Northern India and Guzerat to indicate the drug imported from Persia under the name of Zalil, and

* Yellow is a most auspicious colour amongst the Hindus, the garments of the bride are dyed of this colour The word Trayamana still exists in the Persian language, with the meaning of "yellow" and "diarrhœa."

described in Mahometan works on Materia Medica as Zarir. In Bengal and Southern India the drug is unknown, and *Ficus heterophylla*, *Linn. fil*, is used as a substitute for it under the names of Balábahula and Valli-teragam. The author of the Makhzan-el-Adwiya says :—" Zarir grows in the Khorjáu hills and is called Asfrak by the people of Shiráz, and Arjikan by the Greeks*; the stem is about a span high, flowers yellow, like those of Asfar-i-barri, surrounded by a few soft prickles, leaves yellowish, small, root more than a span long. Asfrak is cold and dry with slight heating properties: also detergent, anodyne and diuretic; it is useful in spleen, jaundice and dropsy; mixed with barley meal, it forms a poultice, which is of much service in inflammatory swellings; its ashes are useful in itch. Maximum dose 5 dirhems†; it is also used as a yellow dye." In India and Persia it is now chiefly used for dyeing silk. Edgeworth brought this drug to notice many years ago, and supposed it to be derived from *D. altissimum*. The true plant has been discovered by Aitcheson in the moister localities of the Badghis and Khorasan at an altitude of 3,000 feet. He says that when in flower it gives a wondrous golden hue to the pastures. (One of the Sanskrit synonyms is Sita or moonlight.)

Description.—The drug consists of the flowers, leaves, flower stalks, and a small proportion of the immature fruit, all of a light greenish yellow colour, and having a somewhat honey-like smell; the flowers are pubescent; many of them tolerably perfect, resembling in size and shape those of the common single Larkspur; the fruit consists of three follicles, which are arranged like those of the aconite and dehisce on the inside; they are marked with prominent longitudinal ribs, have pointed apices, and are supported upon a stout curved peduncle; the seeds are numerous, angular, and of a light-brown colour. The drug when placed in water immediately tinges it a bright yellow, and communicates a bitter taste to it.

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* Arjikan is apparently the Sanskrit word अर्जक.

† Five dirhems—240 grains in 24 hours in decoction. A reference to the chemical composition will show that this dose may possibly prove dangerous.

Microscopic structure.—The seeds are thickly set with white feather-shaped hairs, arranged in rows.

Chemical composition.—The drug reduced to powder lost 23·5 per cent. of moisture when heated to 100° C. The ash amounted to 17·8 per cent. Treated with 94 per cent. alcohol 13·4 per cent. of a dark reddish, bitter, acid extract was obtained. The extract was mixed with water acidulated with hydrochloric acid, and repeatedly agitated with ether. During agitation, blackish resinous matter separated, while the ether became turbid from the separation of a white principle.

On filtration of the aqueous solution 2·6 per cent of a dark resinous body was obtained, which was soluble in ammonia to the extent of 2·54 per cent. The ammoniacal solution was of a dark brown colour, the addition of acids caused the precipitation of dirty yellowish flocks; this principle had the properties of an acid resin. The residue insoluble in ammonia amounted to ·06 per cent., and was white; it was not further examined.

The ethereal solution after filtration yielded 1·63 per cent. of extractive, the residue on the filter was white, and had the physical characters of the principle left after the action of ammonia on the black resin already mentioned. The ethereal extract was redissolved in ether, and agitated with ammonia. On separating the ether, it left on evaporation ·69 per cent. of a greenish-yellow oily residue, from which a white crystalline principle slowly separated. This crystalline principle will be referred to again. The ammoniacal solution yielded with acids brownish-yellow flocks, which had the properties of an acid resin; this principle would appear to be similar to the dark resin left as a residue after agitation of the original aqueous solution with ether.

The original aqueous acid solution left after separation of the ether was repeatedly agitated with amylic alcohol. The separated amylic alcohol was agitated with ammonia, which became coloured of a deep yellow hue; on separating the

amylic alcohol, it left on evaporation ·51 per cent. of a neutral, yellow, transparent principle insoluble in alkaline solutions. This principle was not further examined. The deep yellow ammoniacal solution yielded yellow flocks on the addition of acids, which were redissolved on agitation, the resulting solution being of a dirty brown colour; the addition of alkalies again caused the liquid to assume its original deep yellow colour. This principle had the properties of an acid, and will be referred to subsequently. The amylic alcohol extract also afforded evidence of the presence of a tannin, which gave with erric chloride a deep greenish coloured solution.

The original aqueous acid solution was now rendered alkaline by ammonia and agitated with ether. The separated ether had a marked blue fluorescence, on evaporation a slightly yellow transparent varnish-like residue was left, soluble in acids, the resulting solution possessing a bitter taste. Alkalies caused the precipitation of white flocks easily soluble in ether, and precipitates were obtained with all the alkaloidal reagents; no distinctive colour reactions were yielded. The crystalline principle referred to as occurring in the ether extract obtained from the aqueous acid solution of the extract had the same properties as the alkaloid now described, indicating that the principle was separable by ether both from an acid and alkaline solution. The alkaline original aqueous solution was now agitated with amylic alcohol; the separated amylic alcohol left on evaporation a yellow residue, which was partially soluble in acids. After filtration to separate insoluble matter, the clear aqueous solution yielded yellowish flocks with alkalies, insoluble in ether, but dissolved by amylic alcohol. The solution of the principle in acids had a yellow colour and was bitter to taste, and gave a precipitate with the ordinary alkaloidal reagents; some of the colour reactions were similar to those yielded by berberine. Regarding the nature of these two bitter alkaloids, though they afforded reactions with reagents which were not inconsistent with their being delphinine and berberine respectively, but

without data regarding their ultimate composition, it would be premature to definitely designate them.

The yellow acid separated by amylic alcohol is of interest, because to its presence the tinctorial value of the drug as a dye-stuff is doubtless due. In order to obtain the acid in a pure state the following method was tried:—A concentrated aqueous solution of the plant was precipitated with lead acetate, and the yellow precipitate well washed by decantation. The washed precipitate was diffused through water acidulated with hydrochloric acid, and the separated chloride of lead removed by filtration. The yellow solution was agitated with amylic alcohol; on evaporating off the amylic alcohol a deep yellowish red extract was obtained, easily soluble in water, and possessing a marked acid reaction. The addition of acids caused the precipitation of yellow flocks, soluble on agitation; the addition of alkalies caused the liquid to assume a deep yellow colour. The aqueous solution gave a dirty olive-green coloration with ferric chloride, due probably to the presence of a trace of tannin. The aqueous solution agitated with water acidulated with sulphuric acid in a sealed tube at 100° C. for some hours afforded a turbid solution, which contained dark brown flocks, and which precipitated an alkaline solution of copper on boiling.

The principles separated from the drug may be arranged as follows:—

Dark acid resin.
White neutral principle.
Yellow neutral principle.
Colourless bitter alkaloid.
Yellow bitter alkaloid.
Tannin.
Yellow acid.

Commerce.—Trayamán or Gul-jalil is imported into Bombay and Northern India from Persia, and is of some importance as a yellow dye for silk. It is worth about Re. ½ per lb.

NIGELLA SATIVA, *Sibthorp.*

Fig.—*Zorn. Ic.* 119. Small Fennel-flower (*Eng.*), Nielle, Toute épice (*Fr.*).

Hab.—The Mediterranean countries. Cultivated in India.

Vernacular.—Kalajira, Mugrela (*Hind., Beng.*), Kalonji (*Bomb.*), Karun-shiragam (*Tam.*), Karijirigi (*Can.*), Nalla-jilakara (*Tel.*), Kalejiré (*Mar.*), Shuniz, Siyah dánah (*Pers.*).

History, Uses, &c.—According to Birdwood, it is the Black Cummin of the Bible, the Melanthion of Hippocrates and Dioscorides, and the Gith of Pliny.* Ainslie mentions its use as a carminative, also as an external application mixed with sesamum oil in skin eruptions, as a seasoning for food, and as a protection for linen against insects. Forskahl, in his Medicina Kaharina, says that it is a native of Egypt, where it is called Hab-es-souda.† Roxburgh believes it to be a native of Hindostan. Anyhow, it must have been long known in India, as it has a Sanskrit name, Krishnajiraka. Nigella seed is extensively used as a spice, and as a medicine; it is prescribed by the Hindus with other aromatics and plumbago root in dyspepsia. The Hakeems describe it as heating, attenuant, suppurative, detergent and diuretic, and consider that it increases the menstrual flow and the secretion of milk; also that it stimulates uterine action. They give it, too, as a stimulant in a variety of disorders which are ascribed to cold humours, and credit it with anthelmintic properties. It is sprinkled over the surface of the bread made by Mahometan bakers along with Sesamum seed. (*See Cuminum Cyminum.*). M. Canolle has recently published (*De l'avortement criminel*

* Ibn. 19, 52, 20, 71; Cels. 2, 31; Scrib. Comp. 131.

† الحبة السودا El-habbat-es-souda, i.q. الشونيز El-shooniz, or properly الشينيز El-sheeniz, for thus the Arabs called it according to Ibn-el-Aarabi, or, as some say, i.q. الحبة الخضرا El-habbat-el-Khizra, because the Arabs often call black اخضر and green اسود. This seed is said in a tradition to be a remedy for every disease except death (*Madd-el-Kamus.*)

à Karikal. Thèse de Paris, 1881,) the results of clinical investigations undertaken in the hospital at Karikal with black cummin seed. He has observed that after doses of 10 to 40 grams of the powdered seed the temperature of the body is raised, the pulse accelerated, and all the secretions stimulated, especially those of the kidneys and skin; in doses of 10 to 20 grams they possess a well marked emmenagogue action in dysmenorrhœa, and in larger doses cause abortion.

Description.—The seed is triangular, the umbilical end being smaller than the other, black, ⅛th of an inch long, testa rough; inside the testa is a white oily kernel. When rubbed, the seed diffuses a pleasant odour of lemons, with a slight *soupçon* of carrot.

Chemical composition.—The seeds of *Nigella sativa* have been analysed by H. G. Greenish (*Phar. Jour.* (3) X., 909 and 1013), with the following results.—One hundred parts of the seeds contain: Moisture 7·43, Ash 4·11, Fixed oil 37·00, Volatile oil 1·64, Albumen (sol. in water) 8·22, Mucilage 1·90, Organic acids ppt. by Cu. 0·38, ditto by Pb 0·59, Sugar (Glucose) 2·75, Arabic acid (?) 3·21, Undetermined substance 1·79, Albumen (sol. in soda) 2·14, Metarabin 1·36, other substances dissolved by soda 5·38, Melanthin 1·41, Traces of oil, &c., removed by Alcohol 0·53, dissolved by Chlorine water and Sulphuric Acid 3·85, removed by Chlorate of Potash and Nitric Acid 7·52, Cellulose 8·32—total 99·56. *Melanthin* bears a close analogy to helleborin; like saponin, it possesses considerable emulsifying powers. Greenish has also obtained melanthin from all the aerial parts of *N. sativa*, but found it absent in the roots at all periods of their growth.

Commerce.—The Indian market is supplied from Northern India, Basara, and Cabul. Price 2 annas per lb.

PÆONIA OFFICINALIS, *Linn.*

Fig.—*Bot. Mag.*, *t.* 1784. Officinal Peony (*Eng.*), Pivoine officinal (*Fr.*).

Hab.—*Europe.* The tubers.

Vernacular.—Úd-şálap (*Hind.*), Ude-sálam (*Bomb.*).*

History, Uses, &c.—This drug is the female Peony of Dioscorides, and was esteemed by the ancients as a valuable remedy in uterine obstructions, colic, bilious obstructions, dropsy, epilepsy, convulsions and hysteria. Dioscorides describes two kinds of Peony, male, *P. corallina*, and female, *P. officinalis*, † these are the two kinds of Fawánia described by Arabic and Persian writers. Galen describes its acrid qualities and emmenagogue virtues, and its use as an astringent in diarrhœa. According to Pliny, the name Pæonia is derived from Pæon, the physician of the gods, who was the first to discover this plant. Hippocrates mentions the use of the seeds in uterine obstructions. The roots of *P. corallina* are turnip-shaped and about as thick as the thumb; those of *P. officinalis* consist of oblong tubercles attached by a stout fibre to a rhizome. The plant and roots are figured by Guibourt (Vol. III., p. 763). Úd-sálap is used by the natives as a blood-purifier for children. In the time of Galen a superstition prevailed that Peony root enclosed in a bag and hung round a child's neck both prevented epileptic attacks and cured them, and this belief is not extinct among the peasantry of Europe even now; they also believe that wearing the seeds will prevent the dangers of dentition. Macer Floridus (*De Vir. Herb.*) says:

> 'Illius radix, pueris suspensa caducis,
> Non modicum prodest, Galenus ut asserit auctor.'

The plant has been proved not to be inert; it produces headache, noise in the ears, confused vision, colic and vomiting if taken in full doses (60 grs.). Modern observation has neither confirmed nor condemned the ancient opinions concerning it; and although some have reported favourably of it

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* Corruptions of عود الصليب (Aod-el-salib) or '*wood of the cross*,' an Arabic name for the root of *P. corallina*, because on section it shows two lines crossing one another, which are not seen in the female Peony.

† Dios. iii. 148; Plin. 25, 10, 27, 60.

in epilepsy, chorea, and whooping cough, the evidence in favour of its efficacy is very slender.

Description.—The dried tubers are from 1 to 3 inches in length, and ½ inch to ¾ inch in diameter, tapering to a point at both ends; the external surface is brown and channelled longitudinally; the interior is starchy and white; the cortex on section is seen to be hard and gritty and of a yellowish colour; taste slightly acrid; the central starchy portion is almost tasteless. The odour of the freshly cut tuber is faintly acrid.

Chemical composition.—Wiggers obtained from the fresh root a distillate having the odour of bitter almonds, and acquiring a blood-red colour by ferric chloride; separated by means of ether the volatile oil had a pale yellow colour; the analysis of the fresh root by Morin proved the presence of starch, sugar, fat, malates, oxalates and phosphates, a little tannin, &c. (Stillé and Maisch, *National Dispensatory*, 3rd Ed., p. 1122.)

Commerce.—The tubers are imported from Turkey.

COPTIS TEETA, *Wall.*

Fig.—*Griff. Ic. iv., t.* 660, *f.* 2.

Hab.—Assam, China, Tibet. The rhizome.

Vernacular.—Mámírán, Mishmí títa (*Hind., Bomb.*), Haladio-vachnag (*Guz.*), Sou-line or Chynlen (*Chin.*).

History, Uses, &c.—The μαμιρὰς of Paulus Ægineta, who doubtless obtained his knowledge of it from the early Indian traders; the drug probably passed by the same commercial route as it does now, viz., from China to Western India, and thence to Europe. Mámírán is noticed by the early Arabian writers as a kind of Turmeric (Urúk). The plant is described by Mir Muhammad Hussain "as having leaves like ivy; it is said to grow near water in the hilly parts of India, China, and Khorasán. The Indian kind is described

as yellow with a brown tinge; the Chinese as yellow; the Khôrasán as greenish brown; the seed is said to be like sesamum. The best kind is the Chinese, which should be small, yellow, hard, and knotty; it is said to keep good for twenty years." Whether the three kinds here described are all varieties of Coptis, it is impossible to decide. Indian writers say that Mámírán used as a collyrium clears the sight, and as a snuff the brain, and that it relieves toothache. Internally it is given in jaundice, flatulence, and visceral obstructions Bernier, who visited Cashmere in the train of the Emperor Aurangzebe, mentions Mámírán as a medicine very good for the eyes, which was brought into that country by caravans from Thibet. It was first described by Wallich in 1836. (*Trans. of Med. and Phys. Soc. of Calcutta*, VIII., 85.) It is worthy of notice that this drug, and extract of Barberry (Rusot), both containing a large quantity of berberine in a soluble condition, are used as collyriums by the natives in certain catarrhal and rheumatic affections of the conjunctiva. (*Cf.* Prof. Simpson in *Phar. Jour.* 1854, Vol. XIII., p. 413.) Lately Coptis root has been chiefly used as a tonic by Europeans in India; it has the advantage of acting gently on the bowels. Extended observation of the action of Coptis root shows, that during recovery from malarial fever and in atonic dyspepsia (the inward fever of the natives) it is a valuable medicine, restoring the appetite and giving tone to the system. It may be administered in infusion (one ounce to a pint of boiling water) or in tincture (one ounce to a pint of rectified spirit) in doses of two drachms of the tincture or two ounces of the infusion; or the two preparations may be combined.

Description.—Two distinct varieties of this drug are met with in the Indian market. The kind most esteemed is a yellowish rhizome, as thick as a crow-quill or larger, having a few spinous projections where rootlets have been broken off; the whole rhizome is jointed, but at the upper end the joints become much more marked, and a stem clasping petiole often remains attached to each. The roots are described by Paulus

as having many knuckle-like joints—μαμίρας οἷον ῥίζιόν τι πόας ἔχον ὥσπερ κονδύλους πυκνούς. The second kind is as thick as a goose-quill, and covered with thin wiry rootlets, it often branches at the crown into two or three heads, which terminate in tufts of leaf stalks, crowded together, and not separate as in the first kind; the rhizomes of both kinds are contorted, and have a short fracture, the centre is spongy, and the surrounding portion bright yellow and woody; taste purely bitter. The first kind corresponds with the description of Coptis root in the *Bengal Dispensatory*. The second kind with the description in the Pharmacographia, which appears to refer to *Coptis anemonæfolia*. (*See Pharm. Journ.* (3) X., p. 23.)

Microscopic structure.—The bark of the second kind is much the thickest, and is softer and more corky than that of the first, in both kinds bundles of orange-coloured schlerenchymatous cells are present, and the medullary rays contain starch; the wood is arranged in distinct wedge-shaped bundles, round a central parenchymatous portion, having a structure similar to that of the inner cortex.

Chemical composition.—Coptis root contains 8½ per cent. of berberine so combined as to be easily soluble in water; the nature of this combination has not yet been determined. E. Z. Gross has separated from *Coptis trifoliata, Salisb.*, *coptine*, a colourless alkaloid. Coptine forms with potassio-mercuric iodide a crystalline precipitate which dissolves in Sulphuric Acid to a colourless liquid, becoming purple-red when heated. (*See Atisine.*)

Commerce.—Both kinds of the drug come to Bombay from China, *viâ* Singapore, in bulk. The first sort is worth Rs. 3¼ per lb.; the second Rs. 2. The first kind is also imported into the plains of India from Assam in small egg-shaped baskets.

THALICTRUM FOLIOLOSUM *DC.*

Fig.—*Royle Ill.*, *t.* 51.

Hab.—Temperate Himalaya, Khasia Hills. The root.

Vernacular.—Pílíjarí, Shuprak (*Hind.*), Gurbiani, Pashmaran (*Punj.*).

History, Uses, &c.—The genus Thalictrum is found in the temperate and cold northern regions of Asia, it is very rare in the South, but one species, *T. Dalzellii*, is found on the mountains of the Western Peninsula. In Europe *T. flavum*, under the names of *Meadow Rue*, *Rue des près*, *Fausse rhubarbe*, *Rhubarbe des pauvres*, *Unachte rhabarber*, *Wiesenrante* and *Pigamo*, has long been used as a rustic medicine on account of its tonic and aperient properties. *T. foliolosum*, and perhaps another species from Arracan, have been used for a similar purpose in India from an early date. It is, perhaps, the Pitaka of Sanskrit writers. We have been able to identify as Thalictrum root the drug which is occasionally to be seen in the shops under the name of *Piarunga*,* and which is treated of at great length in the Makhzan-el-Adwiya as a root which is brought from Arracan to Sylhet and Islamabad, and thence distributed to other parts of India. The people of Arracan appear to consider it as a panacea. The following information as to the properties of *Pilijari* is contained in the *Bengal Dispensatory* where the result of a trial of the root, supplied from the Saharunpore Gardens, is related :—"Five grains of the powder, or two grains of the watery extract given three times a day in some cases prevented, and in others moderated, the accession of fever, and at the same time acted gently on the bowels. The only sensation experienced was warmth at the epigastrium and a general comfortable feeling." (*Beng. Disp.* p. 161.) The Piarunga of the shops in the form of a tincture has been administered to some extent at the European General Hospital, Bombay, and found to be a good bitter tonic. Recently the root of *T. foliolosum* obtained from the Superintendent of the Saharunpore Gardens has been used with very satisfactory results in Bombay as a remedy for atonic dyspepsia accompanied with a febrile condition of the system. (*Dr. Peekey.*)

Description.—Roots long, nearly straight, without rootlets, stout and woody, from ½ inch or more to ¼ inch in diameter

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* Probably the same drug as the Pia-amou-leckof Ainslie.

Bark smooth, wrinkled longitudinally, yellowish brown; wood hard, very porous, and of a bright yellow colour, when wet it stains the fingers yellow. Magnified, the porous woody stem is seen to be traversed by medullary rays consisting of several rows of elongated cells: the bark shows a brown suber, and numerous rows of tangentially extended cells; opposite the terminations of the medullary rays, the cells take a rounded form and their arrangement becomes irregular; between the terminations of the medullary rays there is a large deposit of yellow colouring matter with thickening of the cell walls, forming yellow columns which extend to the suber and often end in patches of liber cells. The root at first sight might be mistaken for liquorice root; it is extremely bitter.

Chemical composition.—Thalictrum root contains a large quantity of berberine, so combined as to be readily soluble in water.

Commerce.—It occasionally appears in the shops in small quantities as Piranga root. Supplies can be obtained, if ordered from Mussoorie, through the Superintendent of the Government Gardens.

CLEMATIS TRILOBA, *Heyne.*

Hab.—Mountains of Western India.

Vernacular.—Morwel (*Mar.*).

This plant, and probably another Himalayan species, *C. nepâlensis*, *Dc.*, is mentioned by Sanskrit writers under the name of Laghukarni (light-ear) as a remedy in leprosy, blood diseases, and fevers.* In the Concan the juice of the leaves mixed with that of the leaves of *Holarrhena antidysenterica* is dropped into the eye to cure staphyloma; about two drops are used.

* The *Clematis vitalba*, *Linn.* κληματὶς ἑτέρα of Dioscorides was used for similar purposes by the Greeks. The plants of this genus have acrid properties. Braconnot has observed that the active principle may be distilled with water and is soluble in fixed oils.

Description.--Climbing, all softly silky; leaves small, on longish petioles, simple or ternately divided, elliptic ovate or cordate, 3-nerved. Panicle many flowered; lower bracts leafy, flowers 1½ to 2 inches diam., white, appear in September; sepals 4 to 6, membranous, oblong, silky outside; filaments narrow, linear, glabrous Many other species of Clematis grow in the temperate Himalaya, but do not appear to be used medicinally.

ACTÆA SPICATA, *Linn., Eng. Bot.* 13, 918.

Baneberry (*Eng.*), Herbe de Saint-Christophe (*Fr.*).

Grows in the temperate Himalaya from Bhotan to Hazara: it is also a European plant, and a variety with red berries is well known in America. It does not appear to be known as a medicinal plant to the Hindus, its chemical constitution is the same as that of *Cimifuga racemosa.* (See next article.) It is probably the Actæa of Pliny, 27. 26.

CIMIFUGA FŒTIDA, *Linn., Lam. Ill.* 487

Bugbane (*Eng.*), Cimicaire (*Fr.*).

Is a native of the temperate Himalaya from Bhotan to Cashmere; it also occurs in Europe and Siberia. We have no knowledge of its use by the Hindus. In America *C. racemosa, Elliot,* (*Actæa racemosa, Linn.*), Black Cohosh, is used medicinally and is a depressant of the nervous and vascular systems, causing giddiness, nervous tremour, depression of pulse, nausea, and increased pulmonary and cutaneous secretion; in excessive doses it is an irritant emeto-cathartic and often causes violent delirium. The plant affords a crystalline neutral principle slightly soluble in ether and water, freely so in chloroform and alcohol. The latter solution has a pungent acrid taste. *C. fœtida* has not been examined.

The medicinal plants of minor importance belonging to the *Ranunculaceæ* and known in India are the following:—

Anemone obtusiloba, *Don., Royle Ill.* 52, t. 11, f. 1, is a native of the temperate and Alpine Himalaya, the root of

which, Stewart says, is mixed with milk and given internally for contusions, and used externally as a blister. Persian and Arabian medical writers describe several kinds of Anemone under the name of Shakayak-el-Naaman; they copy closely from the Greeks, with the addition that these plants are used with Walnut husks for dyeing the hair black. (*Cf.* Dios. II., 167; Pliny, 21, 94.)

Caltha palustris, *Linn.*, *Eng. Bot.* 8, 506. The Marsh-marigold is a native of marshes in the western temperate Himalaya. It is a common European plant. The natives of India consider the roots to be poisonous.

Delphinium Brunonianum, *Royle*, *Bot. Mag.* t. 2461.

Vernacular. Sámp-phali (*Hind.*). Is a native of the Punjab Himalaya, and is prized for its strong scent of musk. It is offered to idols, and Aitchison says that the juice is used to destroy ticks in animals. (*Journ. Linn. Soc.*, XVIII., p. 25.)

Delphinium cœruleum, *Jacq.*, *Eng. Bot.* 7, t. 8.

Vernacular.—Dakhangu. Is a Punjab plant, the root of which is used to kill maggots.

Delphinium denudatum, *Wall.* Is also a Punjab plant. Stewart says the root is chewed to cure toothache.

Peonia emodi, *Wall.*, *Bot. Mag.* 5719. Is the *Mamekh* of the Punjab and a native of the temperate Himalaya. It is said by Watt to be used in the same way as *P. officinalis*, *Linn.*

Ranunculus sceleratus, *Linn.*, *Eng. Bot.* 10, 681.

Vernacular.—Kabikaj (*Pers.*). Is a native of Northern India. It is one of the plants known as Batrachion to the Greeks, which Galen says should not be used on account of their acrid properties. The Romans called these plants *Ranunculus*. Fée and Hardouin consider it to be the same as the *Apiastrum* of Pliny and identify it with the *Ranunculus Sardous* of Crantz, the plant which produces a contraction of the mouth, famous

as the "Sardonic grin." It is called in English, Water-Crowfoot and Celery-leaved Crowfoot, and in Arabics, Kaf-es-saba. (*Cf.* Dios. II., 166; Pliny 25, 109.)

REMARKS.—Galen tells us that the Anemones are emmenagogue and galactagogue, and have acrid, drawing, cleansing and opening properties; when chewed they increase the secretion of saliva. The juice cleanses the brain when administered by the nostrils, and lessens or removes opacities of the cornea; it cleanses ulcers and cures scaly skin diseases if applied locally, &c. In Europe the drug appears to have fallen into disuse until about the end of the eighteenth century, when Störk again brought it to notice, and latterly in America several species of Anemone, under the name of Pulsatilla and their active principle anemonin, have been rather extravagantly praised as remedies for a long list of diseases. When pure anemonin is given to rabbits in doses of from 5 to 10 grains, it reduces the pulse, and respiration rate and the temperature; causes dyspnœa and stertor, debility, and then paralysis of the limbs, stupor, dilatation followed by contraction of the pupil, and death without convulsions. On dissection, the heart and great vessels and the veins of the brain and medulla are found distended with dark blood. (*Clarus.*) Externally it acts as an irritant to the skin. The extract and tincture of the plant differ from pure anemonin, inasmuch as large doses cause inflammation of the stomach and bowels and death with convulsions. The cause of this difference has not been ascertained. Applied to the tongue, both the drug and anemonin cause a sense of burning followed by numbness. In medicinal doses, (4 to 5 grains of the herb or ⅙ to ⅓ a grain of anemonin) the drug is now considered to act as a general stimulant and diuretic.

The different species of Anemone and Ranunculus when distilled with water yield a distillate, from which ether extracts a very acrid yellow oil (anemonol) which is gradually, or more rapidly in the presence of water, converted into anemonin and anemonic acid, from which hot alcohol dissolves

the former. Anemonin forms colourless friable crystals, which are neutral, inodorous, and when fused exceedingly acrid; it is soluble in chloroform, but nearly insoluble in ether and water. Formula $C^{15} H^{12} O^{6}$. (*Fehling.*) Anemonic acid $C^{15} H^{14} O^{7}$ is a white crystalline very insoluble powder, which dissolves alkalis with a yellow colour.

Some species of Delphinium contain the alkaloids delphinine $C^{22} H^{35} NO^{6}$, and staphisagrine $C^{22} H^{32} NO^{5}$, the former very closely resembles aconitine in its physiological action and is antidotal to muscarine and digitalin; the latter paralyses the motor nerves like curare. Both of the alkaloids are soluble in alcohol, but delphinine may be separated from staphisagrine by means of ether in which the latter is insoluble.

MAGNOLIACEÆ.

ILLICIUM VERUM, *Hook. f.*

Fig.—*Bot. Mag. t.* 7005. *Star-anise tree* (*Eng.*), *Badianier* (*Fr.*).

Hab.—Cochin-China. The fruit.

Vernacular.—Bádián-i-khatai (*Pers.*), Anasphal (*Hind.*), Anna shuppu (*Tam.*), Bádián (*Bomb.*), Anása-puvvu (*Tel.*).

History, Uses, &c.—It would appear that star-anise has long been in use in China and Japan; but was not known in India until a comparatively recent date. Persian works on Materia Medica, written about one hundred years ago, speak of it as a new medicine. The authors of the Pharmacographia trace its introduction into Europe as far back as 1588; in those days it came by way of Russia, and was known as Cardamomum Siberiense. Mr. J. G. Scott, in a paper read before the Royal Geographical Society, describing Cua-ai, where the Chinese and French

Commissioners met for the delimitation of Tongking, says: "Maize, white and red rice, and the star-anise seem to be what the people chiefly cultivate upon the hill slopes. The star-anise is an evergreen shrub, with a leaf not unlike the Bay, and a pentagonal fruit very highly scented. From this is obtained the oil called by the Tonkinese *Dau hoi* (scented oil) and by the French *Huile de badiane*. The Chinamen boil the fruit in a huge caldron with water, inside this caldron there is a small internal vessel filled with cold water, which is constantly renewed. The steam and oil are condensed on the sides of this vessel, and are drawn off by a small bamboo runlet into the receiver; another runlet allows the water from this pan to drain back into the boiler. One boiling lasts over a day and a half, and produces about 15 pounds of oil. A picul, 117 lbs. weight, of the oil costs between £30 and £40 At present the greater part of the star-anise oil goes into China."

In Native medicine star-anise is considered to be hot and dry in the second degree; and is described as carminative, expectorant, and diuretic; it is often given in infusion with tea, and is also mixed with food as a spice. In European medicine it is described as an aromatic, stimulant and carminative. It is a favourite adjunct to cough mixtures, and on account of its sweet taste is specially suitable as a carminative for children.

Description.—For a very complete description of the commercial article, see *Pharmacographia*, p. 21. An Indian species, *I. Griffithii*, occasionally finds its way into the market; it has narrower and more numerous carpels, one or two only in each fruit are fertile; a handful of fruit upon examination proved to be all provided with 13 carpels; they are of a dark reddish brown colour, much wrinkled on the under surface; the seeds correspond with those of *I verum*; the taste is feebly aromatic at first, afterwards bitter and astringent. The oil of Star-anise is free from the peculiar fatty smell of aniseed oil. (*Umney.*)

Microscopic structure.—The fruit of *I. Griffithii* has the same structure as that of *I. verum*, but in the external loose dark brown layer of cells, hardly any globules of essential oil can be seen; on making sections for the microscope the knife is immediately stained black by tannin, which is not the case with *I. verum*; for a microscopic description of the latter article consult the *Pharmacographia*, p. 21. Wood-cuts of the fruits of *I. verum*, *I. religiosum* and *I. Griffithii* may be found in a paper by Mr. E. M. Holmes in the *Pharm. Journ.*, 3rd Series, XI., 489.

Chemical composition—Star-anise contains from 4 to 5 per cent. of volatile oil, which is chiefly solid and liquid anethol, like that of *Pimpinella Anisum*. The specific gravity is 0·978, molecular rotation 0° to 0·4, with the chloral reagent [1] it affords eventually a red colour like Ol. Fœniculi. Its other reactions are similar to those obtained with aniseed oil. Star-anise contains much sugar, probably cane. (*Eijkman.*) Umney has pointed out that the congealing point of the oil when at rest is about 35° F., whereas that of aniseed oil is about 50°. When stirred, the congealing point of both oils is from 50° to 60° F.

The fruit of *I. Griffithii* would appear to contain some bitter principle as well as tannin. According to J. F. Eijkman, the fruit of *I. religiosum*, which has poisonous properties, contains proto-catechuic acid, shikimmic acid and shikimipicrin. The latter would appear to be the poisonous principle; it forms large transparent crystals, melting at 200° C., which are freely soluble in water, forming a neutral solution with a very bitter taste. The formula is $C^7 H^{10} O^5$ or $C^{10} H^{14} O^4$. In the volatile oil of the leaves he discovered eugenol, shikimen and shikimol; the second is, he thinks, a terpine, and the last identical with safrol. (*Rec. Trav. Chim.* IV., 32—54, *Year-Book of Pharm.*, 1885, p. 171.)

Commerce.—Star-anise is shipped to India from China in large quantities, and two qualities are met with, selected in

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[1] Alcohol saturated with H Cl

boxes worth Rs. 17 per Surat maund of 37½ lbs., and broken in bags, value Rs. 14 per maund. The oil which comes from China in 12 catty tin jars sells for about Rs. 4½ per catty.

MICHELIA CHAMPACA, *Linn. var. Rheedii.*

Fig.—*Wight Ill i., t. 5, f.* 6. Golden or Yellow Champa (*Eng.*), Champac (*Fr.*).

Hab.—Temperate Himalaya, from Nipal eastward; Pegu, Tenasserim, Nilgiris and Travancore Commonly cultivated. The bark.

Vernacular.—Champa (*Hind., Beng.*), Shampang (*Tam.*), Pivalá-cháphá (*Mar.*), Ráo champo (*Guz.*), Sampangi-puvvu (*Tel.*), Sampage-huvvu (*Can.*).

History, Uses, &c.—There appear to be several varieties of Michelia which have been produced by cultivation. *M. Rheedii,* which is referred by Hooker and Thomson to *M. Champaca,* is cultivated in India for the sake of its yellow, sweet-scented tulip-like flowers, which are made into a wreath (*veni*) and worn by women at the back of the head. The Champa, in Sanskrit Champaka or Dipapushpa (lamp flower) appears to have been cultivated in India from a very early date; it has many synonyms expressing praise of its delicate form, golden colour and intoxicating perfume.

The bark is mentioned in the secondary list of the Pharmacopœia of India as having febrifuge properties; but the natives of India do not generally use it, nor is it to be met with in the shops. According to Rheede and Rumphius the flowers are diuretic and are used in gonorrhœa to relieve scalding, pounded with cocoanut-oil they are applied as a plaster to inflamed parts. The root is said to be emmenagogue, and the oil of the seeds is rubbed into the abdomen to relieve flatulence.

Description.—The fresh bark is covered externally by a light brown epidermis, which can be easily removed by friction; beneath this, it is of a reddish brown colour mottled with

longitudinal green stripes, and pale yellow scars of irregular form; the inner surface is yellowish and fibrous, taste feebly bitter, with a faint aroma. It contains tannic and gallic acids.

Microscopic structure.—It is chiefly remarkable for aggregations of large stony cells of a bright yellow colour. The parenchyme contains much starch.

MICHELIA NILAGIRICA, *Zenker.*

Fig.—*Zenker Plant Ind. t.* 20. Hill Champa (*Eng.*).

Hab.—Higher mountains of the Western Peninsula and Ceylon. The bark.

Vernacular.—Shempangan, Sempagum (*Tam.*), Sapu (*Cing.*).

History, Uses, &c.—This tree, like the Champa, yields a valuable timber. The bark is said to have been made into decoctions and infusions and used as a febrifuge, but there is no evidence of its being used for that purpose at the present time.

Description.—The stem bark is covered with a light brown, corky layer, which scales off or may easily be removed when dry; it is brittle, and its irregularly broken surface is frequently beset with lichens and mosses. Between the cork and intermediate layer are pinkish masses of various forms. The surface of the middle layer is pale brown; in the fresh state it is marked with longitudinal green stripes; it is hard and dense, and very much resembles the bone at the base of horns. A fracture shows that the middle layer is dense and of a reddish colour, and the inner layer dirty yellowish-brown, tough, and of fibrous consistence. The inner surface is russet-brown, and striated with the fine longitudinal marks of the white liber tissue. A transverse section touched with a drop of ferric chloride solution shows that tannin is present in the two inner layers only. The bark affords a light cinnamon-brown powder, slightly bitter in taste, with a faint terebin-

thinnate odour. The bark of the branches and younger stems is uniformly pale brown, less bitter, and more aromatic.

Chemical composition.—The powdered bark gave 10·6 per cent. of moisture, and left 9·7 per cent. of ash. It contained a volatile and a fixed oil, acrid resins, tannin, giving a greenish-black colour with ferric salts, sugar, a bitter principle, mucilage, starch, calcium oxalate, &c. Search was made for alkaloids and mannite, with negative results. A decoction did not give the usual blue colour with iodine until a considerable quantity of the reagent had been added, a reaction peculiar to cinnamon and cassia barks.

Commerce.—The oil of *Michelia nilagirica* which was stated (*Pharm. Journ. Oct.* 22, 1887, p. 314,) to be obtained from this bark, was in reality distilled from the bark of *Cinnamomum Wightii*, a tree found on the hills of Southern India.

ANONACEÆ.

ANONA SQUAMOSA, *Linn:*

Fig.—*Rheede, Hort. Mal.* iii., 29; *Bot. Mag.* 3095; *Gartn. Fruct. ii., t.* 138. The Custard Apple tree (*Eng.*), Cachiman (*Fr.*).

Hab.—Tropical America, cultivated in India. The seeds, leaves and bark.

Vernacular.—Sitáphal (*Hind., Mar.*), Sita-pullam (*Tam.*), Ata, Lúna (*Beng.*), Sita-pundu (*Tel.*), Atta (*Cing.*).

History, Uses, &c.—The custard-apple has been long naturalized in India, and has received the Sanskrit name of Gandhagátra. The seeds, leaves, and immature fruit, contain an acrid principle which is destructive to insect life; the seeds are much used by the natives for removing lice from the head;

they require to be applied with caution; for if any particles get into the eye, much pain and redness is produced.' The author of the Makhzan notices the poisonous action of the seed upon lice, and says that when applied to the os uteri, they cause abortion. The fruit is called Sharifah and Káj in Persian. Rheede states that the ripe fruit mixed with salt is used as a maturant. The root is considered to be a drastic purgative, and is administered by the natives in atrabilis or melancholia, much as Hellabore was by the Greeks. In the Antilles, Guiana and Reunion the leaves are employed to make a sudorific infusion (thé Corrossol), and in India the crushed leaves are applied to the nostrils of women suffering from hysterical or fainting fits.* The leaves are also used to destroy maggots in sores, and to assist in removing the Guinea-worm.

Description—Seed dark brown, polished, with two lateral ridges, tapering towards the umbilical end, where there is a prominent ring, with a central pit, length about five-eighths of an inch, breadth two-eighths, albumen large, ruminated, embryo minute. Leaves oblong, obtuse or acuminate, glaucous beneath, 2—3 by $\frac{3}{4}$—$\frac{1}{2}$ inch, pubescent when young, when dried black, odour when crushed pungent and offensive.

The fruit is globose or ovoid, light green, tuberculous, the size of a large apple, and is composed of the numerous, confluent, ripe carpels, each of which contains one large seed, pulp sweet, of a delicate spicy flavour, easily digested.

Microscopic structure.—The testa of the seeds is composed of two sets of yellow rod-like cells, with a narrow central cavity, the outer set are arranged vertically but the inner project into the albumen and divide it into numerous small bundles. The albumen consists of large polyhedral cells filled with starch.

Chemical composition.—The seeds yield an oil and resins; the latter appear to be the acrid principles.

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* Rheede notices the use of the unripe fruit in a similar manner in vertigo.

The bark has been examined by Pedler and Warden, who found indications of an alkaloidal principle, but failed to isolate it in a pure state; they also found an acid resin insoluble in ether, and two resins soluble in ether; as well as a white crystalline principle soluble in alcohol and ether, but insoluble in water or dilute acids, and a viscid yellow neutral resin-like body.

BOCAGEA DALZELLII, *H. f. & T.*

Hab.—Forests of the Concan and Travancore. The leaves.

Vernacular.—Sájeri, Kochrik, Hárkinjal, (*Mar.*).

Description.—Leaves polished, narrow-oblong, acute or obtuse, 5—9 inches long by 1—2 broad, coriaceous, serrated, base acute or rounded; flowers white; carpels globose, smooth, about one inch in diameter, usually containing two mature seeds. Graham, under the name of *Guatteria laurifolia,* describes this tree as like the Portugal laurel, and says that it flowers in November, and bears fruits the size of a marble, which when cut open have an agreeable smell like the wild English Angelica. In the Concan, the leaves are used as a fomentation in rheumatism by the natives; they have a pungent, astringent and bitterish taste. The tree yields a valuable reddish timber which is used in house building.

Chemical composition.—The leaves contain tannin, giving a blue-black precipitate with ferric salts, and a very small quantity of gallic acid. The aqueous extract contains a ferment which produces a pungent alliaceous odour as soon as an infusion is made of the leaves. It is precipitated from its aqueous solution by alcohol, and is to some extent dissolved again by heat. The distillate is oily, with a pungent odour and taste, and neutral in reaction. The leaves also contain a crystalline body extracted by boiling alcohol from the marc left by ether and cold alcohol exhaustion; it is probably the body related to sinigrin of mustard seed, which gives the pungent property in contact with water. The leaves yield 7·8 per cent. of ash.

MENISPERMACEÆ.

JATEORHIZA CALUMBA, *Miers.*

Fig.—*Bentl. and Trim.*, *t.* 13. Calumba (*Eng.*), Colombo (*Fr.*).

Hab.—Oibo, Mozambique. The root.

Vernacular.—Kalamb-ki-jer (*Hind.*), Kalamb kachri (*Bomb.*), Kalamba ver (*Tam.*), Kalamba-veru (*Tel.*).

History, Uses, &c.—Calumba grows in the forests of East Africa, along the Mozambique Coast, in the Zambesi country, and Madagascar; the Arabs call it Sák-el-hamám, 'dove's foot,' from the resemblance of the hairy ovaries with their three-parted stigmas to the leg and foot of a dove. The drug appears to have been first introduced into India by the Portuguese. In Africa it would seem to have been long used as a medicine in dysentery, and other affections of the bowels. Flückiger and Hanbury's researches have traced its introduction into Europe to the Portuguese, as far back as 1671. Shortly after this date, Francisco Redi noticed it as an alexipharmic. It would then appear to have been neglected until re-introduced by Percival in 1773; since then it has been in constant use in Europe as a mild tonic. The older English physicians in India probably became acquainted with it through the Portuguese The plant was introduced into Madras in 1805, and subsequently into Bengal and Bombay; but it appears now to have died out. Calumbin, the non-nitrogenous crystalline bitter principle occurring in Calumba-root together with berberine is usually represented as not possessing much physiological activity. Dr. Lauder Brunton says (*Pharmacology*, p. 757), it seems to have less action than berberine. But some experiments made with the separated crystalline principle, and reported by M. Houdé (*Repértoire*, *March*, 1886, p. 113), point to it being a somewhat energetic substance, giving rise to vomiting and diarrhœa. In small doses it appeared to augment the secretion of bile, of the glands

of the stomach, and the intestine; after full doses the liver appeared to undergo granular fatty degeneration. A dose of 10 centigrams administered to fowls caused death, preceded by digestive disturbance and frequent evacuation. It is thought that if it were not that calumbin is present in Calumba in only small amount (0·35 to 0·4 per cent.) it would prove an inconvenient constituent in the administration of the drug. (*Pharm. Journ.*, 1886.) Calumba appears to owe its tonic action chiefly to berberine (*see* Berberis); it also possesses the advantage of containing no tannin, and consequently does not form an inky mixture with salts of iron. It is used in atonic dyspepsia and debility of the digestive organs, and appears to increase the secretion of bile. Trousseau and Pidoux recommend it especially when there is subacute inflammation of the gastric mucous membranes, with a bitter taste in the mouth, heat and pain at the epigastrium, nausea, slight fever and perhaps diarrhœa.

The powdered root has been used for dressing unhealthy sores.

Description.—The drug consists of nearly round or oval transverse slices of the root, varying much in size; these, when freshly imported, are of a light, bright greenish yellow colour, and have their edges covered by a wrinkled, corky epidermis; the surface of the slice shows a central portion, often much contracted in the middle, the vascular bundles standing out as rough projections, and a cortical portion from two to three-eighths of an inch thick. Calumba is light and breaks easily with a short starchy fracture, the odour is mossy, and the taste very bitter.

Microscopic structure.—Commencing externally we find a range of tabular cells forming the suber; within this, a broken line of thick-walled yellow cells; and next a cellular parenchyme loaded with starch and yellow colouring matter, making up the bulk of the bark, and intersected by radiating bands of liber tissue. The central portion of the root consists of a starchy parenchyme, intersected by radiating bands, formed

of bundles of large vessels, which are more or less surrounded by a layer of wood cells. The starch granules are very large and ovoid.

Chemical composition.—The root contains calumbin, berberine and calumbic acid. Calumbin may be obtained by treating the root with alcohol of 75 per cent., the alcohol is recovered, and the residue, after evaporation, dissolved in water, and shaken with ether, which takes up fatty matters and the calumbin; the latter is purified by crystallization from boiling absolute ether; it forms right rhombic prisms, and is neutral and very bitter. Calumbic acid was obtained by Bœdecker by adding hydrochloric acid to the product obtained by the treatment of an alcoholic extract of calumba by lime water; it forms strongly acid white crystalline flakes. Both calumbin and calumbic acid are very sparingly soluble in cold water or cold alcohol, and ether. (*Dict. de Chimie; Wurtz.*, Vol. 1, p. 959.) Bœdecker has pointed out a connection between these three bitter principles.

If we suppose a molecule of ammonia NH^3 to be added to calumbin $C^{42}H^{44}O^{14}$, the complex molecule thence resulting will contain the elements of berberine $C^{20}H^{17}NO^4$, calumbic acid $C^{22}H^{24}O^7$, and water $3H^2O$ (*Pharmacographia*, p. 25) Duquesnel has recently published the following process for obtaining calumbin. Exhaust the powdered root with 95 per cent. alcohol, recover the alcohol, treat the syrupy residue with chloroform. Filter the chloroform solution and evaporate; treat the residue with 60 per cent. alcohol which dissolves most of the colouring matter. The residue, which contains the calumbin, is dissolved in strong alcohol, decolorised with animal charcoal and crystallized. The yield should be 0·35 to 0·4 per cent.

Commerce.—Calumba root is imported into Bombay from the Mozambique Coast to the extent of from 200 to 400 bales annually.

The bales are of matting, and contain about one cwt. each, value Rs. 3½ per Surat maund of 37½ lbs.

ANAMIRTA COCCULUS, *W. & A.*

Fig.—*Rheede, Hort. Mal.* vii., *t.* 1; *Bentl. and Trim. t.* 14. Cocculus Indicus (*Eng.*), Coque du Levant (*Fr.*).

Hab.—Concan, Malabar, Eastern Archipelago, Eastern Bengal, Assam. The fruit.

Vernacular.—Kakámari (*Hind., Can., Tel., Beng.*), Kákphal (*Guz.*), Karwi (*Mar.*), Kakkáy-kolli-virai (*Tam.*), Heuber, Netrmala (*Punjab*)

History, Uses, &c.—This plant, which is a large climbing shrub with rough corky bark, is probably the Kákaphala of Sanskrit writers; its properties must have been known to the Hindus from an early date, and the fruit appears to have been long in use as a remedy in certain skin affections, possibly of parasitic origin. The Arabs were probably also acquainted with it, but there is no satisfactory evidence upon this point to be gathered from their writers upon Materia Medica. Sprengel would make it the Mahur-harj of Ibn Sina, but this is evidently incorrect; as Ibn Sina describes that plant as "like *Shibram* (Tithymalus), which some people class among the milky shrubs." According to Flückiger and Hanbury, Ruellius was the first European writer who mentioned it (*De Natura Stirpium, Paris,* 1536), under the name of Cocci orientis. Gerarde calls it Cocculus Indicus; it also bore the name of Coccole di Levante (Levant berries), from its being introduced into Europe through the Levant ports. In the Concan the juice of the leaves with that of the root of *Gloriosa superba* is used to kill Guinea-worms. Rumphius, vii., 18, notices its use to kill fish, and also birds of Paradise, by poisoning the holes full of rain water in the trees they frequent. He says that in Ceylon and Malabar they catch wild cattle, &c., by poisoning Jack fruits with it, and placing them in the woods

Picrotoxin, the active principle of the seeds, has been found useful in the night sweats of phthisis in doses of $\frac{1}{120}$ to $\frac{1}{60}$ of a grain; it is also employed to destroy pediculi in the form of

an ointment (10 grs. to 1 oz.), and is official in the United States Pharmacopœia.

When administered internally it stimulates all the motor and inhibitory centres in the medulla, especially the respiratory and vagus centres. It also irritates motor centres, either in the cerebrum or in the medulla and cord, producing in all vertebrates alternating epileptiform spasms, with periodic stoppage of the motions of the diaphragm and slowness of the pulse. The spasms often take the form of swimming, running backwards or round in a circle (manège movements), or rolling of the body on its axis. The temperature is somewhat raised. (*Lauder Brunton.*) Some preliminary experiments made by Professor Arpad Bokai go far to show that picrotoxin is probably the best antidote for morphia poisoning. It is said to prevent paralysis of the centre of respiration, by which death from morphia is caused. It has also exactly the opposite effects of morphia on the pressure of the blood.

Description.—A somewhat reniform purple fruit, the size of a small grape, growing in a long bunch, each branch of which supports from 1 to 3 of the drupes. The dry fruit is about the size of a large pea, dark brown, and wrinkled; below the concavity on one side there is a circular scar, to which a portion of the peduncle sometimes remains attached; above it is a small pointed projection, the remains of the style; within the dried pulp is a thin shell, which at the concave part of the fruit dips in deeply to form a placenta, which projects in the shape of two lobes into its cavity, upon these the kernel is moulded, and has consequently a cup-shaped form, the cavity of the cup being marked by a longitudinal ridge, corresponding to the fissure between the two lobes of the placenta. The kernel consists of two layers of albumen, which, when separated, disclose a superior radicle, from which two thin cotyledons diverge, narrow at first, but afterwards widening. Cocculus Indicus is very bitter, and if kept long has a rancid oily smell.

Microscopic structure.—The albumen is composed of polyhedral cells containing crystals of fatty matter.

Chemical composition.—The pericarp is said to be emetic, and to contain two crystallizable tasteless substances, menispermine and paramenispermine, but this is doubtful, and requires confirmation. Picrotoxin, a crystalline substance, was discovered in the seed by Boullay in 1812; it is the poisonous principle, and is soluble in water and alkalis. Fluckiger and Hanbury give the following summary of its properties:—"Picrotoxin does not neutralize acids, it dissolves in water and in alkalies; the solution in the latter reduces cupric oxide like the sugars, but to a much smaller extent than glucose. The alkaline solution is not precipitated by chloride of ammonium. The aqueous solution is not altered by any metallic salt, or by tannin, iodic acid, iodohydrargyrate or bichromate of potassium; in fact, by none of the re-agents which affect the alkaloids. It may thus be easily distinguished from the bitter poisonous alkaloids, although in its behaviour with concentrated sulphuric acid and bichromate of potassium, it somewhat resembles strychnine as shown in 1867 by Kohler. Picrotoxin melts at 200° C; its composition $C^9 H^{10} O^4$, as ascertained in 1877 by Paternò and Oglialoro, is the same as that of evernnic, hydrocoffeic, umbellic and veratric acids." (*Pharmacographia*, p. 32)

By fractional distillation from Benzol, Barth and Kretschy (1880) separated picrotoxin into three bodies. One, for which the name picrotoxin was retained, melts at 201° C., and has the composition $C^{15} H^{16} O^6 + H^2 O$. The second, *picrotin*, $C^{25} H^{30} O^{12}$, has similar properties, but melts at at 250° C., is less freely soluble in benzol, and is not poisonous. The third compound, *anamirtin*, $C^{19} H^{24} O^{10}$, remains in the mother liquor on re-crystallizing picrotoxin from water; it is but slightly bitter, is not poisonous, and its alkaline solutions do not reduce metallic salts. Warnecke has obtained from the fruit 5·20 per cent. of ash.

Toxicology.—This drug is occasionally used in Madras and Bombay as a cattle poison. During the last ten years four cases have been reported. In Bombay one case has been

reported in which it was used to facilitate the commission of theft. The symptoms are stomach ache, nausea, vomiting, tetanic convulsion, insensibility and sometimes delirium. Dr. Burton Brown notices its use as a poison in the Punjab.

Commerce.—Cocculus Indicus is brought to the Western ports in large quantities for exportation to Europe; it is hardly ever used in India, and is seldom to be seen in the druggists' shops. Value, Rs. 3 per Surat maund of 37½ lbs.

CISSAMPELOS PAREIRA, *Linn.*

Fig.—*Bentl. and Trim., t.* 15.

Hab.—Tropical and sub-tropical India. Cosmopolitan in warm regions. The root.

Vernacular.—Dakhnirbishí, Pahári, Hárjori (*Hind.*), Pahármúl (*Mar.*), Páta (*Tel.*), Tikri, Katorí (*Sind, Panjab*), Karandhis (*Guz.*), Ponmutootai (*Tam.*).

History, Uses, &c.—The plant appears to have been long in use as a bitter tonic and diuretic in Northern and Southern India, and is mentioned by Ainslie. Chakradatta recommends it in fever with diarrhœa and in internal inflammations; it is combined in native practice with bitters and aromatics. In Europe it has never been an article of commerce, though for a long time it was supposed to produce the Pareira root of the shops (*confer. Pharmacographia, p.* 25). The Sanskrit names are Ambáshta, Páthá and Venívela (braided creeper), Pahadamula and Ákanádi. In the Punjab and Sind the leaves and roots are employed in the cure of ulcers and in Pudukota for dysentery. The drug is not used in Europe; it appears to act as a mild tonic and diuretic. It is reputed to be antilithic.

Description.—The root is about half an inch in diameter, bark light brown, marked with longitudinal furrows, and transverse constrictions, sometimes very crooked and knotty, from

growing in stony ground, seldom branched, fracture fibrous, bark corky, and thick for the size of the root, wood yellowish, in from 10 to 15 wedge-shaped bundles, containing many large vessels, and separated by narrow medullary rays; odour none; taste very bitter.

Microscopic structure—It cannot be distinguished from several other Menispermaceous roots common in India.

Chemical composition.—The pelosine or cissampeline of Wiggers, which Flückiger has found to be identical with beberine, exists in this root to the extent of about ½ per cent. (*Flückiger.*) Pelosine is amorphous, nearly insoluble in water, somewhat soluble in ether and carbon bisulphide, freely soluble in chloroform and acetone, also in alcohol and benzol; its nitrate is sparingly soluble, and its acetate is precipitated by sodium phosphate, by the group re-agents for alkaloids, and by iodide, ferrocyanide, ferridcyanide, and chromate of potassium; the precipitate with phosphomolybdic acid dissolves in ammonia with a blue colour. The formula of beberine is $C^{19} H^{2} NO^{3}$.

Stephania hernandifolia, *Wall., Wight Ic. t.* 939, extending from Nipal to Chittagong, Singapore and Ceylon, has similar properties, and is known by the same native names as *Cissampelos Pareira.* It is the Águád (Ákanádi) of Bengal, where the striated stems are sold in the bazars; but it seems probable that the true Sanskrit name of this plant is Vanatiktika.

TINOSPORA CORDIFOLIA, *Miers.*

Fig.—*Rheede, Hort. Mal. vii.,* 21; *Bentl. and Trim., t.* 12.

Hab.—Tropical India. The stem.

Vernacular.—Gurach, Giloe, Gulancha (*Hind., Beng.*), Gulwail, Guloe, Gharol (*Mar.*), Típpa-tíge (*Tel.*), Shindíl-kodi (*Tam.*), Amrita-balli (*Can.*), Rassakinda (*Cing.*), Gurjo (*Sikkim*), Amritwel (*Goa.*), Gado (*Guz.*).

History, Uses, &c.—A well-known medicinal plant, long in use in Hindu medicine, and called in Sanskrit Guduchi, Pittaghni (bile-destroying), Bhishakpriya (dear to physicians), Nirjara (not perishing), &c. It is considered to be cold and dry, or according to Arabic and Persian writers, hot and dry in the first degree. In native practice it is much valued as an antiperiodic in fevers, and as a tonic and alterative; it is also credited with aphrodisiac properties.* The fresh plant is said to be more efficient than the dry; it is taken with milk in rheumatism, acidity of the urine and dyspepsia. The juice with Pakhanbed and honey is given in Gonorrhœa, and is an ingredient in Paushtiks given in *Phthisis*. In Guzerat, a necklace called Kamalá-ni-málá (jaundice necklace) is made of small pieces of the stem, and is supposed to cure that disease. The stem, if placed upon a bush in the open air, will retain its vitality through the hot season, and when the rains commence, put forth leaves and long whipcord-like roots, which soon reach the ground, whence the Sanskrit synonym Chinnaruha, or, growing when cut. The plant is very common in many parts of India, and may always be obtained in the green state. Elephants are very fond of the stems, and the hill tribes in Sikkim give it to their cattle to cure pains in the stomach. The dry stem is to be seen in every drug shop; from it is prepared a kind of starch known in Hindustani as Giloe-ka-sat, and in some parts of India as Palo. It is prepared by powdering the stem and washing out the starch with water; the latter retains a little of the bitterness of the drug. *T. cordifolia* appears first to have attracted the notice of Europeans in India at the early part of the present century, and to have been favourably spoken of by those who have tried it as a tonic, antiperiodic and diuretic, but it has never come into general use in European practice. It is now official in the Pharmacopœia of India, and has lately (1884) been re-introduced to the notice of the profession in Europe as a specific tonic, antiperiodic and diuretic. (*Zeitschrift des Oesterr. Apoth. Ver.*, 1884, 312.)

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* **For original Sanskrit prescriptions, see Dutt's Hindu Materia Medica, p. 105; most of them contain several other equally active remedies.**

Description.—The fresh stem has a green succulent bark, covered by a thin brown epidermis, which peels off in flakes; it is studded with warty prominences, and here and there gives off roots and branches bearing smooth heart-shaped leaves, and bunches of red berries; when dry it shrinks very much, and the bark separates from the wood, and becomes of a dull brown colour; the latter consists of a number of wedge-shaped bundles; the taste is very bitter; the odour not in any way peculiar.

Microscopic structure.—The suber consists of tabular cells, and thick-walled yellow cells, in alternate layers; the woody portion is not to be distinguished from that of several other Menispermaceous plants common in India.

Chemical composition.—The extract called *Palo* and *Sat-i-giloe* is simply starch, which, through not having been washed, retains some bitterness, that sold in the bazaars is usually nothing but common starch. The stem has been examined by Flückiger (1881) by boiling it with alcohol and a little hydrate of calcium, the alcohol was then evaporated and the residue extracted by means of chloroform The latter liquid was found to contain an alkaloid in very small quantity; on evaporating it and dissolving the residue by means of acidulated water, a solution was obtained, which proved to contain merely a trace of berberine. The alcoholic extract after it had been exhausted by chloroform as above stated, was dissolved in boiling water and precipitated by tannic acid, avoiding an excess of the acid. The deposit thus obtained was mixed with carbonate of lead, dried and exhausted with alcohol, which on evaporation yielded the bitter principle. By boiling this bitter principle with dilute sulphuric acid, sugar was produced and it lost its bitterness. Neither the original bitter principle or the product derived from it could be crystallized.

Commerce.—The stems are collected and dried by the country people who bring them for sale to the towns. Value, Rs. 2½ per Surat maund of 37½ lbs.

COCCULUS VILLOSUS, *DC.*

Fig.—*Pluk. Am.*, *t.* 384, *f.* 3, 7.

Hab.—Tropical and subtropical India. The roots and leaves.

Vernacular.—Jamti-ki-bel, Farid-buti (*Hind.*), Vasanvel, Tána (*Mar.*), Dagadi (*Can.*), Chipuru-tiga, Katle-tiga (*Tel.*), Huér (*Beng.*), Káttuk-kodi (*Tam.*); Pátála-galori (*Guz.*).

History, Uses, &c.—A very widely-distributed plant of climbing habit, very common everywhere; it has no doubt been long in use as a domestic remedy in all parts of the country, but few of the native works on Materia Medica notice it. The Sanskrit names are Pátála-gárudi, Vásadani and Vásana-valli, "giving a fragrant perfume." It is a disputed point whether this plant or the *Pedalium murex* is the true *Faríd-bútí* upon which *Sheik Faríd is reputed to have sustained* life for some time. The juice of its leaves mixed with water has the property of coagulating into a green jelly-like substance, which is applied externally by the country people under various circumstances on account of its cooling nature, and is also taken internally sweetened with sugar as a cure for Gonorrhœa. Pliny (24, 99) mentions two plants, Coracesta and Callicia, which, according to Pythagoras, were used by the Magi to congeal water. The root is said to be alterative, and to be a good substitute for Sarsaparilla. Roxburgh says that a decoction of it in goat's milk flavoured with long pepper is administered in rheumatic and old venereal pains, and is considered heating, laxative and sudorific. (*Fl. Ind.* III., 815.) The juice of the ripe berries makes a durable, bluish-purple ink. (*Brandis.*) In the Concan the roots rubbed with Bonduc nuts in water are administered as a cure for belly-ache in children, and in bilious dyspepsia they are given in 6 massa doses with ginger and sugar; they are also an ingredient with a number of bitters and aromatics in a compound pill which is prescribed in fever.

Description.—Leaves 2 to 3 by 1½ to 2 inches, sometimes sublanceolate, retuse or obtuse, and mucronate; sometimes

three-lobed, base subcordate or truncate, when young villous on both surfaces; petiole ½ inch long. Root very crooked and twisted upon itself, keeled, seldom branched, but giving off a few thin fibrous rootlets; external surface light brown, nearly smooth, transverse section pale yellow, marked with radiating darker yellow lines; odour peculiar, acrid; taste disagreeable and bitter.

Chemical composition.—The air-dried stems and roots were well bruised in a mortar and extracted with rectified spirit in a Thorn's extractor. The resulting tincture was then evaporated at a low temperature on a water bath till free from alcohol. Water was added to the viscid extract, and the turbid mixture, which possessed a strong acid reaction, was repeatedly agitated with ether. During agitation a large amount of dark, soft resinous-looking matter separated and adhered to the bottom of the bottle. The original extract was thus divided into three portions—ethereal solution A, separated resin B, aqueous residue C.

The ethereal solution A, which was of a dark yellowish-brown hue, was agitated with dilute hydrochloric acid; during agitation the aqueous acid solution became turbid from the separation of dark brown flocks. The ether was separated and was of a yellowish colour; it left on spontaneous evaporation a yellowish-green soft resin which possessed a very fragrant odour, not unlike that of Tolu balsam. Treated with benzol it was partially soluble. No further examination was made of this portion.

The aqueous solution filtered from the brown flocks above mentioned, was of a dark brown colour. The addition of ammonia caused the separation of pinkish flocks, and the solution acquired a reddish hue. The turbid solution was now agitated with chloroform-ether which acquired a pink colour. The separated chloroform-ether left on evaporation a pink residue, non-crystalline, soluble in alcohol, the colour being that of a tincture of Sander's wood. The alcoholic solution did

not exhibit any fluorescence, and the colour was the same when viewed by either reflected or transmitted light; examined spectroscopically there was marked absorption towards the violet end of the spectrum, with a slight absorption in the yellow, but no bands. The addition of dilute acids to the alcoholic solution altered the colour to dirty yellow. Some of the dry extract was treated with water, and gently heated, a dark resin-like mass was insoluble; the aqueous solution had an acid reaction, and a fragrant odour. A few drops of dilute H Cl were now added and the clear yellow solution filtered from insoluble matter, and agitated for a very brief period with chloroform. The chloroform, of a yellow colour, was separated; on evaporation the extract was not wholly soluble in dilute H Cl. The filtered acid solution gave with alkalies a pink colour, while brick-red flocks separated, not soluble in excess: the addition of dilute acids immediately destroyed the red colour. With potassio-mercuric iodide, phospho-molybdic acid, platinic and auric chlorides, and picric acid, marked amorphous precipitates were yielded.

The aqueous acid solution which had been agitated with chloroform for a short period only, was now rendered alkaline with ammonia and again agitated with chloroform. The chloroform was separated, and evaporated off at a gentle heat, the residue was dissolved in dilute H Cl., with alkalies white flocks separated, and the solution further gave precipitates with all alkaloidal re-agents.

These experiments would indicate that two principles were extracted, one possessing the properties of an acid, and yielding a red colour with alkalies, the other an alkaloid.

The reddish alkaline solution left after agitation with chloroform-ether, was gently heated to expel ether, and when cold acidified with dilute H Cl.; when the colour changed to dirty green; the solution was then agitated with chloroform, which acquired an emerald-green colour. On evaporating off the chloroform a green varnish-like non-crystalline residue was left. The chloroform solution examined spectroscopically

showed some absorption towards the violet end of the spectrum, but no bands. The liquid did not exhibit any fluorescence, and was of the same colour viewed either by reflected or transmitted light. The extract was readily soluble in alcohol; more readily soluble in ether than in benzol. The addition of a few drops of dilute H Cl. and water, dissolved the greater part of it, the resulting solution being of a dirty green colour. The addition of alkalies caused the separation of pink flocks, and the solution became of the same colour. A precipitate was also yielded with the usual alkaloidal re-agents. Subsequent addition of an acid caused the liquid to regain its original green hue, and the solution when again agitated with chloroform coloured it an emerald green. The action of alkalies on the green chloroform extract was extremly marked, the slightest trace of an alkali being sufficient to determine the production of the pink coloration. Boiled with alcoholic potash, the red coloration of the liquid was not destroyed, but on the addition of dilute acids yellow flocks separated, which were soluble in chloroform with production of a yellow solution without any tinge of green. The aqueous solution was also yellow.

These experiments appear to indicate that the reddish alkaline solution contained an acid principle associated with an alkaloid. It would appear that the alkaloid contained in this second fraction was similar to the one to which reference has already been made. The two acid principles, however, do not appear to be identical: in the one case the chloroform solution of the acid was yellow, in the other emerald green. In their behaviour towards alkalies they also differed in the tint of the colour reaction. These principles do not appear to be of the nature of ordinary chlorophyll, but possibly they may be allied to the colouring matter stated to be present in certain lichens, &c., or to decomposition products of chlorophyll.

Separated resin B, was soluble in alkaline hydrates, and reprecipitated in brown flocks by acids. The resin was not further examined.

Aqueous residue C—The filtered solution was rendered alkaline with ammonia and agitated with chloroform-ether, brownish flocks separated. The separated chloroform-ether left on spontaneous evaporation a transparent yellowish varnish-like residue. In order to purify this extract it was dissolved in dilute acetic acid in which, with the exception of a few flocks it was wholly soluble. The filtered solution was agitated with chloroform several times; finally the liquid was rendered alkaline and again agitated with chloroform. On separating and evaporating off the chloroform, a faintly yellowish transparent residue was left; this residue was practically insoluble in water: it was easily dissolved by alcohol, and also soluble in ether, but the solutions did not crystallize on slow evaporation. The alcoholic solution was bitter; it did not exhibit fluorescence. In dilute acids, especially tartaric acid, the extract was soluble, the resulting solutions being bitter. With nitric, hydrochloric, sulphuric, acetic, and tartaric acids no crystalline compounds could be obtained. From an acid solution alkalies precipitated white flocks, which were redissolved by acids. An acid solution responded to all the ordinary alkaloidal re-agents. A solution in sulphuric acid after boiling did not reduce an alkaline copper solution. A solution of the extract in dilute hydrochloric acid was precipitated by platinic chloride in excess, the amorphous light yellow precipitate collected on a filter, well washed, and dried in a vacuum over concentrated sulphuric acid. Two determinations of the metal in this salt yielded 19·07 and 18·91 per cent., respectively, of platinum, which gives a mean of 18·99 per cent. of platinum. During ignition of the platinum salt there was a very strong odour of benzoic acid. This principle had the properties of an alkaloid, at present its ultimate composition has not been determined. The chloroform which was first agitated with the original alkaline aqueous solution, left a reddish varnish-like residue, which also gave all the reactions of an alkaloid, and which appeared to be similar to the principle separated from the alkaline solution; the alkaloid being thus separable both from an acid and an alkaline solution by chloroform, &c.

This alkaloid was doubtless the one which was found associated with the colouring principle, and to which reference has already been made. The colouring principle gave similar reactions to the one already described. The original aqueous alkaline solution left after agitation with chloroform was filtered; and then agitated with amylic alcohol. The amylic alcohol solution was of a deep claret colour: it was agitated with dilute hydrochloric acid. The amylic alcohol on evaporation left a light green varnish-like residue insoluble in water or in dilute hydrochloric acid. The addition of ammonia to the solid extract dissolved a portion, the solution being of a damson-red colour. The residue insoluble in ammonia was of a dirty brown hue. The addition of acids to the ammoniacal solution precipitated pale greenish flocks.

The hydrochloric acid solution of the amylic alcohol extract was of a deep brown colour, carbonate of soda was added, which precipitated brown flocks, and the solution agitated with amylic alcohol. The amylic alcohol became of a damson red colour. On evaporation a damson coloured varnish-like residue was left, partially soluble in water acidified with hydrochloric acid; the solution was strongly bitter and harsh: a trace of tannin was present. The addition of alkalies occasioned the precipitation of white flocks: with the ordinary alkaloidal re-agents precipitates were obtained. The principle possessed the properties of an alkaloid, but appeared to differ from the first one described in being more easily soluble in dilute acids, and in possessing a much more marked bitter taste, accompanied by harshness. The amount isolated was far too small to admit of any examination of its platinum salt.

The colouring principles which have been isolated by the action of amylic alcohol were probably similar to those obtained earlier in the analysis by the action of chloroform, &c. The aqueous residue left after the action of amylic alcohol was not further examined.

Commerce.—Not an article of commerce.

COSCINIUM FENESTRATUM, *Colebr.*

Fig.—*Miers. in Hook. Bot. Mag.*, *t.* 6458; *Contrib.* *iii.* 22, *t.* 88. Tree Turmeric, False Calumba (*Eng.*).

Hab.—Western Peninsula, Ceylon. The stem.

Vernacular.—Jhár-kí-haldí (*Hind.*, *Bomb.*). Mara-manjal (*Tam.*), Dodamara-darasina (*Can.*).

History, Uses, &c.—The stem is said to have been long in use in Ceylon and Southern India as a bitter medicine, and as a yellow dye. We have not met with any account of it in native works; but there is reason to believe that it has sometimes been confounded with Darhalad, the stem of the Barberry. Ainslie was probably the first European physician who noticed it. He says:—"Mera Munjil is the Tamil name of a round yellow-coloured bitterish root, common in the bazaar, about one inch in circumference, employed in preparing certain cooling liniments for the head, and is also used as a yellow dye; it is brought from the mountains, but I have endeavoured in vain to ascertain the plant." Subsequently it attracted attention in Ceylon by being mistaken for Calumba, and some of it found its way to Europe, where it became known as False Calumba and Tree Turmeric; it is favourably noticed in the Pharmacopœia of India; and is used at the present time in the hospitals of the Madras Presidency as a bitter tonic. (*See Berberis.*)

Description.—Cylindrical woody stems, diameter 1 to 4 inches, covered with a pale corky bark; wood of a bright greenish yellow colour, and open porous structure, having no concentric rings, but conspicuous medullary rays; taste purely bitter. The wood is much less hard than that of the Barberry, and of a lighter colour.

Chemical composition.—Calumba wood was analysed by Perrins in 1853, and found to contain berberine. (*Phar. Jour.*, Vol. XII., pp. 180—500.)

Commerce.—It is an article of commerce in Southern India only.

The Menispermaceous plants of minor importance sometimes used medicinally, are the following:—

Tinospora crispa, *Miers.*, extending from Sylhet and Assam to Pegu and Malacca. It possesses the bitterness and tonic properties of *T. cordifolia*, and is known by the same vernacular names.

Cocculus Leæba, *D. C.*, *Pluk. Am.*, *t.* 384, *f.* 4, a scandent shrub of the Punjab, Sindh, and Carnatic, which is also found in Afghanistan, Arabia and Persia, has bitter and tonic properties similar to those of *Tinospora cordifolia*. It is known in the Punjab and Sindh as Ullar-billar and Parvati.

Tiliacora racemosa, *Colebr., Rheede Hort Mal.* vii., *t.* 3; *Miers., Contrib.* iii. 76, *t.* 101; a climbing shrub found throughout tropical India and in Ceylon, is one of the three kinds of Mushadi used by the Telingás as remedies for snake-bite. These three kinds are: Mushadi, *Strychnos Nux-vomica*; Naga-Mushadi, *Strychnos colubrina*; and Tiga-Mushadi, *Tiliacora racemosa*. Other vernacular names for this plant are Tiliakora (*Beng.*) and Bága-mushada (*Hind.*); it is bitter like others of the genus, and, it is hardly necessary to say, no antidote to snake poison.

Pericampylus incanus, *Miers.* Under the name of *Bárak-kánta,* slender Menisperaceous stems are sold in the Bengal bazars which appear to belong to this plant.

BERBERIDEÆ.

BERBERIS ARISTATA, *DC.*

Fig.—*Bentl. and Trim.*, *t.* 16. Nepaul Barberry (*Eng.*), Vinettier aristé (*Fr.*).

Hab.—Temperate Himalaya, Nilgiri Mountains, Ceylon.

B. LYCIUM, *Royle.*

Ophthalmic Barberry (*Eng.*), Vinettier tinctorial (*Fr.*).

Hab.—Western Himalaya from Garwhal to Hazara.

B. ASIATICA, *Roxb.*

Fig.—*Deless. Ic. Sel. ii., t.* 1.

Hab.—Himalaya, Behar on Parasnath. The stem, root-bark, extract and fruit.

Vernacular.—The stem, Dárhalad (*Hind.; Bomb.*). The extract, Rasot, Raswanti (*Hind., Bomb.*), Raswal (*Sind.*). The fruit, Zarishk (*Pers., Hind., Bomb.*). Ambarbaris (*Arab.*).

History, Uses, &c.—Various species of Barberry occur on the Himalaya and Nilgiri mountains in India, at elevations between 6,000 and 10,000 feet. The wood (*Dáruharidrá*), extract (*Rasánjana*), and probably the fruit, have been used by the natives from a very early date. The Greeks were acquainted with the extract under the name of Indian Lycium as long ago as the first century; it would appear, though, that there were other kinds of Lycium in use at that time (*Confer Pharmacographia*, p. 34.*) The early Arabian writers were also acquainted with it by the name of Huzaz-i-Hindi,† and mention its Indian name, which some of them derive from Ras, juice, and Uth (*uthna*, to boil). Hakím Abd-el-Hamid describes its manufacture from the powdered wood by exhaustion with water, filtration, and admixture with an equal bulk of cow's milk, the mixture being finally evaporated to the consistence of an extract, and enveloped in leaves; this method of preparation is the same as that described in Sanskrit works.

* Dios. i. 147; Plin. 24, 76, 77; Cels. 5, 26, 6, 7, 8, 6, Scrib. Larg. Comp. 19, in the early stage of ophthalmia.

† They describe two kinds, *Maki* or the λύκιον of the Greeks, and *Hindi* or Indian; the former was derived from *Rhamnus infectorius*, the berries of which are used in dyeing leather yellow.

Royle, in 1833, brought Rusot more prominently to the notice of Europeans; since then it has been pretty extensively employed as a tonic and febrifuge. The root-bark of Barberry is now official in the Pharmacopœia of India, it is noticed in the Tuhfat-el-mumunín under the name of Árghis, and is said to possess all the properties of Mámírán. Surgeon-General Cornish, of Madras, states that the Nilgiri Barberry bark (Mullu-kulla-puttai *Tam.*,) has been used in the treatment of ague with good results A similar opinion appears to be generally held by medical men in India. In the bazaars the stem, extract and fruit are always obtainable; the two first are considered cold and dry, and are prescribed in combination with other bitters and aromatics, as tonics and antiperiodics, especially when bilious symptoms and diarrhœa are present; they are also used in menorrhagia. Rusot mixed with opium, alum, rock salt, chebulic myrobalans, and various other drugs, is much used as an external application in inflammatory swellings, and is rubbed in round the orbit in painful affections of the conjunctiva; it is also used mixed with honey as an application to aphthæ, and abrasions and ulcerations of the skin, and mixed with milk it is dropped into the eye in conjunctivitis. The fruit is cooling and acid. Berberine in doses of 1½ grain given subcutaneously kills rabbits, with symptoms of prostration and fall of temperature; but a dose eight times as great given to them by the mouth has no action, and 15 grains only produce in man slight colicky pains and diarrhœa. Is said to cause contraction of the intestines and of the spleen, and to lessen oxidation in the blood. (*Lauder Brunton.*) The drugs which contain this alkaloid are very useful in malarial dyspepsia accompanied by a febrile condition.

Description and Microscopic structure.—Dárhalad occurs in pieces, 1 to 2 inches in diameter, covered by a soft, corky, light brown bark; beneath this is a hard layer of stony cells, forming a complete coating to the stem; this layer is marked by longitudinal furrows corresponding to the medullary rays, which are very prominent and close-grained, and contain many stony cells; between the rays are wedge-shaped portions of

wood supplied with very large fenestrated vessels, and external to each wedge-shaped portion is situated a peculiar band of a pale yellow colour, which lies in contact with the stony envelope; there is a small close-grained central column, consisting of cells containing starch; all parts of the wood are impregnated with yellow colouring matter freely soluble in water.

Rasot is a dark brown extract of the consistence of opium, having a bitter and astringent taste, readily soluble in water, partly so in rectified spirit, forming a rich yellowish brown solution, which becomes bright yellow when diluted. It is prepared in Nipal and the Dhoon. Zirishk is a moist sticky mass of small black fruit, rather larger than English Barberries; most of them are abortive, but a few contain one or two oblong seeds about 3-20ths of an inch in length, with a thin roughish brown testa, beneath which is a membranaceous covering; the perisperm is yellow, embryo nearly as long as the perisperm, yellow, erect, cotyledons oblong; radicle subcylindric, inferior.

The root bark is brittle, externally light brown and corky, beneath the suberous layer it is of a dark brown, with a greenish yellow tinge, fibrous, and very bitter.

Chemical composition.—The bitter principle of Barberry root and wood is berberine, which it contains in great abundance. The fruit contains tartaric and malic acids. Berberine or berberia was first discovered by Chevallier and Pelletan (1826) in the bark of *Zanthoxylum clava Herculis, Linn.*, and named *xanthopicrit*; its identity with berberine was proved by Perrins (1862). A. Buchner, who obtained it (1835) crystallized from barberry root, believed it to possess acid properties, and named it berberin. It had been previously separated in an impure condition by Brandes (1825) and by Buchner (1830). G. Kemp (1841) noticed that it forms crystallizable compounds with various mineral and organic acids, but its alkaloidal nature was first proved by Fleitmann (1846). Since then it has been discovered in numerous plants of the orders

Berberideæ, Ranunculaceæ, Menispermaceæ, &c. Its composition is $C^{20} H^{17} NO^4$. (*Perrins.*) Berberine dissolves in strong sulphuric acid with a dingy olive-green, and in nitric acid with a dark brown-red colour. Solutions of its salts are precipitated greenish-brown by potassium ferrocyanide, and yellow by picric acid, phosphomolybdic acid, or chloride of gold, platinum or mercury; the precipitates are mostly crystalline or crystallize readily; the phosphomolybdate dissolves in ammonia with a blue colour. Dissolved in hot alcohol, the salts of berberine yield, with solution of iodine in potassium iodide, dark-green scales of metallic lustre and appearing reddish-brown in transmitted light; if an excess of iodine be employed: the crystals are of a red-brown colour in reflected light. Hydrochlorate of berberine assumes with chlorine a blood-red colour. (*Buchner.*) This behaviour furnishes a delicate test, by means of which, according to Klunge, berberine may be detected in over 200,000 parts of solution; brucine, which gives a similar colour with chlorine, yields with acids colourless solutions. Fused with potassium hydrate, berberine is decomposed, yielding two acids, one of which is sublimable, the vapours having the odour of chinolin. (*Hlasiwetz and Gilm.*) Oxyacanthine, $C^{32} H^{46} N^2 O^{11}$, remains in the mother liquor from which the berberine salt has been precipitated by an acid. It is a white alkaloid, turning yellow in sun-light, nearly insoluble in water, and has a bitter taste and alkaline reaction; it is soluble in alcohol, less so in ether, but freely in chloroform, benzol, fats and volatile oils. Sulphuric acid colours it brown-red. Nitric acid imparts a yellow and, when heated, a purple colour. Berbamine $C^{18} N^{19} O^3 N$ and at least another alkaloid are also contained in the root. (*Cf. Stillé and Maisch. Nat. Disp., 3rd Ed., p.* 315, *On Berberine, by W. H. Perkin, jun., Journ. Chem. Soc., Feb.* 1889.)

Commerce.—Dárhalad comes to the plains from Northern India and from the Madras Presidency. Rusot and Zirishk from Northern India. Value, Dárhalad, Rs. 3½; Rusot, Rs. 8-9 per maund of 37½ lbs.; Zirishk, Re. ¼ per lb.

PODOPHYLLUM EMODI, *Wall.*

Fig.—*Jacq. Voy. Bot. ii.*, t. 9.

Hab.—Interior ranges of the Himalaya, Sikkim, Hazara, Cashmere.

Vernacular.—Pápra or Pápri, Bhavan-bakra or bakra, Chimyaka (*Hind.*).

History, Uses, &c.—The genus Podophyllum contains four known species, one Himalayan, one American and two Chinese. The Indian species inhabits shady valleys in the inner ranges of the Himalaya, and is very abundant in Kunawur and Cashmere. The remarkable appearance of its bright red fruit would lead one to suppose that it must have attracted the attention of the Hindus, and judging by the Hindi names *Pápra* and *Bhavan-bakra* it is probable that it was one of the bile-expelling plants, described by Sanskrit writers under the names of *Parpata* and its synonym *Vakra*. In Hindi the Sanskrit *parpata* becomes *pápra* and *vakra* changes into *bakra*; the prefix *bhavan* probably means "hill" and the Hindi name would thus signify "hill vakra" as distinguished from *kshetra-vakra* or *kshetra-parpata*, field vakra or parpata, a name applied to one or more species of Oldenlandia. The modern medical literature of India contains hardly any information about this plant. A specimen of the root was forwarded to the Committee for investigating Bengal drugs, by Dr. Falconer about fifty years ago, but no examination of it appears to have been made. The plant is mentioned in the Pharmacopœia of India as a possible source of Podophyllin, and Stewart says that the fruit is used medicinally in Lahoul.

Description.—Stem or scape 6 to 12 inches, erect, stout, herbaceous; leaves 2, vernal, alternate, long-petioled, plaited and deflexed in vernation, 6 to 10 inches in diameter, orbicular, 3 to 5 lobed to the middle or base; lobes cuneate, acutely serrate; peduncle terminal in bud, then apparently supra-axillary or inserted on the petiole of the upper leaf; flowers 1 to

1½ inch in diameter; sepals very deciduous; petals 6, sometimes 4 (*Royle*), obovate-oblong; berry 1 to 2 inches long, ellipsoid, red. (*Fl. Br. Ind.*) The root agrees with that of *P. peltatum* in most particulars, but differs in the intervals of the knots whence the aerial stems are given off. The rhizome is more or less cylindrical, crowded above with tuberosities, marked by depressed oval or circular scars, and giving off numerous simple rootlets below. The terminal bud is enclosed in whitish, papery sheaths. The colour is yellowish-brown, paler in the rootlets. The fracture is short and mealy, disclosing a white section, with a circular arrangement of yellow vascular bundles, and bounded on the outside by a thin brown cortical layer.

Chemical composition.—The powdered root was macerated in rectified spirit for four days, and the tincture evaporated to dryness, weighed 25 per cent. of the drug. This extract was well washed with water, which removed sugar and bitter colouring matter to the extent of 15 per cent. The remaining 10 per cent. of resin or resins was dried at a low temperature and had a bright brownish yellow colour. The reactions of the resin with tests, and its solubility in chloroform, ether, and diluted alkalies were very similar to those of the official resin of *P. peltatum*.

Half a grain (·035 grm.) taken in the evening produced unmistakably a cathartic action the first thing next morning. A slight griping was experienced.

NYMPHÆACEÆ.

NELUMBIUM SPECIOSUM, *Wight.*

Fig.—*Wight, Ill. i., t.* 9; *Bot. Mag., t.* 903; *Rheede, Hort Mal. xi.,* 30, 31. Egyptian Lotus (*Eng.*), Nélumbium magnifique (*Fr.*).

Hab.—India, Persia, Ceylon, Siam, Cochin-China, Philippines, Moluccas, China and Japan. The flowers.

Vernacular.—Kamal, Kanval (*Hind.*), Alli-támara (*Tel.*), Nyadale-huvu (*Can.*), Kamala (*Mar.*), Sevaka (*Goa.*), Pabán (*Sind.*), Ambal (*Tam.*).

History, Uses, &c.—This is a classical plant amongst the Hindus and Egyptians. The world at its creation is likened to a Lotus flower floating on water. "Om! mani padme. Om! the pearl of creation is in the Lotus. It is emblematic of the heavens. Brahma is supposed to reside on a Lotus flower in a sea of milk, and to sleep six months of the year, and watch the other six months; an allusion to the seasons in which Brahma represents the Sun. Mr. U. C. Dutt, in his Hindu Materia Medica, speaks thus of it:—"These beautiful plants have attracted the attention of the ancient Hindus from a very remote period, and have obtained a place in their religious ceremonies and mythological fables; hence they are described in great detail by Sanskrit writers. The flowers of *N. speciosum*, called *Padma* or *Kamala*, are sacred to Lakshmi, the goddess of wealth and prosperity. The white variety of this plant is called *Pundarika*, the red *Kokanada*, and the blue *Indivara*. The entire plant, including root, stem and flowers, is called *Padmini*. The torus or receptacle for the seed is called *Karnikara*, and the honey formed in the flowers *Makaranda*. The filaments round the base of the receptacle pass by the name of *Kinjalka*, and the leaf stalk by that of *Mrinala*." *N. speciosum* is the κυαμος αἰγύπτιος of Theophrastus. The Arabians and Persians, under the name of *Nilufer*, which, they say, is a corruption of an Indian name, and derived from Nila, water, and Phala, fruit, describe the several varieties of Nelumbium and Nymphæa, and do not appear to consider the flowers of the former plant in any way superior to the latter. They direct the white and blue kinds to be preferred. Both Hindus and Mahometans consider the flowers to be especially cooling and astringent, and consequently prescribe them in a variety of disorders which are supposed to proceed from heated humours, such as sanguineous fluxes from the bowels, &c.; they are given in decoction with liquorice or in the form of a syrup

containing ½ a part of the dried flowers, 1 part sugar, and 5 parts water, dose 2 to 3 drachms. A powder is also used. As an externally cooling application Lotus flowers are made into a paste with sandalwood or emblic myrobalans.

The seeds of *N. speciosum* (Kamal kakri),* and of *Euryale ferox* (Makhána) are used as articles of diet. In times of scarcity the roots and scapes (bisin) of *N. speciosum* are also made use of, but they are bitter and unpalatable. The starch contained in the thick rhizome, separated by rasping and washing, constitutes a sort of arrowroot used by the Chinese, under the name of *Ouan-fen*. (*D. Hanbury*.)

Description.—The calyx consists of four to five deciduous sepals; the corolla of numerous deciduous petals, arranged in several rows; the stamens are numerous, in several rows, attached with the petals to the base of the receptacle; the stigma is sessile; the dry flowers have a brown colour; the seeds are black and like small acorns.

Chemical composition.—The rhizome of *Nymphæa alba* contains an alkaloid which appears to be identical with that obtained from *Nuphar luteum* in its chemical and physical properties, as well as in its behaviour towards group re-agents, but in their colour reactions there is a decided difference; inasmuch as the alkaloid of Nymphaea does not give the green reaction with dilute sulphuric acid which *nupharine* does, and gives the following reactions which are not given by that alkaloid. Concentrated sulphuric acid and potassium chromate colour its solution first red-brown and after some hours clear green; concentrated sulphuric acid alone produces a red brown which passes into grey. Frohde's re-agent colours it first red, then dirty-green. The alkaloid is not present in the blossoms or seeds, it is tasteless, but its acid solution is intensely bitter. The formula is $N^2 C^{18} H^{24} O^2$, the same as that given by Pelletier and Couerbe to menispermine and paramenispermine, and the three alkaloids are probably isomeric.

* Bákla-i-kubti or Bákla-i-nabti of Persian writers (Coptic bean).

The tannins of Nymphæa are notable for yielding many secondary products, which have been individually found in other tannins, but their presence together has not been hitherto noted. Ellagic and gallic acids are easily obtained; another substance, which rapidly absorbs oxygen from the air, and passes into a body of the nature of phlobaphene; and a second substance, which by similar absorption of oxygen passes into two bodies, or assumes two phases with properties similar to chlorophyll.

The rhizome and seeds of Nymphæa also contain resins, glucose, metarabin and fat, besides other substances common to plants. (*W. Grüning, Archiv. der Pharm.* [3], XX., 582—605 and 736—761; *Pharm. Journ.* [3], XIV., 49.)

Commerce.—The seeds are imported from Persia in large quantities as an article of diet. The fresh flowers are brought to market in August for use in the temples. The dried flowers sold in shops as Kamal are generally those of Nymphæa.

PAPAVERACEÆ.

PAPAVER SOMNIFERUM, *Linn.*

Fig.—*Eng. Bot.* 2145; *Bentl. and Trim.*, *t.* 18 Garden Poppy (*Eng.*), Pavot somnifére (*Fr.*).

Hab.—Cultivated in India. The juice, capsules, petals and seeds.

Vernacular.—*Opium*, Afiyún, Afím (*Hind.*), Aphím, Appo (*Bomb.*), Abini (*Tam.*). *Poppy seed*, Kashkásh (*Hind.*), Khaskhas (*Bomb.*), Gashagasha (*Tam.*). *The capsules*, Post (*Hind.*, *Bomb.*), Postaka-tol (*Tam.*).

History, Uses, &c.—Opium is not mentioned by the older Hindu writers; in works of later date it is named in Sanskrit Ahiphena. If we trace the history of the drug, we

find that it was known to the Greeks in the beginning of the third century, B. C., and was probably first collected and prepared in Asia Minor. The Arabians next became acquainted with it, and converted the Greek name Opion into Afiyún, some of their writers mention this derivation, and say that the Greek word means soporific.* It is generally supposed that the Persians and Indians became acquainted with opium through the Arabians, but some Persian writers suppose that the Tiryák which Rustum obtained from Kaikáous to give to Sohráb was opium. For a further account of the history of the drug, the Pharmacographia and other standard works on Materia Medica may be consulted. The poppy generally cultivated in India is the *P. somniferum* var. *album*, with white flowers and white seeds: but a red-flowered and black-seeded variety is met with in the Himalayas. The principal opium-producing region of British India lies in the central tract of the Ganges, bounded by Dinajpur in the east, Hazaribagh in the south, Gorakhpur in the north, and Agra in the west, thus including the districts of Behar and Benares. In 1886-87, 919,852 bighas of land were under poppy cultivation in those districts. The next important opium-producing region embraces the table lands of Malwa, and the slopes of the Vindhya Hills: it is stated that the variety grown there is the *P. glabrum*. The poppy is also grown, but to a smaller extent, throughout the plains of the Punjab, but less commonly in the N.-W. Provinces. In the valley of the Beas, east of Lahore, it is cultivated up to an altitude of nearly 7,500 feet. Most of the outer districts grow poppy to a certain extent, and produce opium for local use. But the drug prepared in the Hill State and in Kulu, forms a staple article of trade for that region. Opium is also produced in Nipal, Baisahir and Rampur, and at Doda Kashtivar, in the Jammu territory: in the Nundidrug district in Mysore, in the Baldasnch district of West Berar, and in Assam.

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* ὀπιον. Latin, Opium or Opion. Plin. 20, 76 Poppy juice. The Arabian lexicographers regard the word as Arabic, the author of the Kámús derives it from the root فين, others from افن.

The revenue derived by Government from the opium monopoly is obtained by two principal means, by allowing the drug to be manufactured by licensed cultivators in the Patna and Benares districts, the opium being purchased by Government at a fixed rate; and, secondly, by the impost of a heavy duty on opium manufactured in native States, but brought in transit to a British port for exportation. The former system obtains in Bengal, the latter in Bombay. The number of licensed cultivators in Bengal always exceeds a million.

The opium industry in Bengal is thus completely under the control and monopoly of Government, and the districts producing the drug are divided between two agencies—one for Bihar, and having its head-quarters at Patna, the other for Benares, at Ghazipore. The opium prepared in the Benares Agency is for the greater part taken by the cultivators to sub-factories (*Kothis*), of which there are several in each district, where the drug is weighed and examined, and finally consigned in bulk to the head factory at Ghazipore. The opium prepared, however, in the home divisions, near the head factory, is taken by the cultivators direct to Ghazipore. The receipt of opium at the head factory is thus conducted under two systems, the first described being termed Challán, and the second Assamiwar. In the Bihar Agency the whole of the opium received at the head factory is Challán.

The lands selected for poppy cultivation are usually in the vicinity of villages. The early sowings are made about the middle of November, and the second and third by the end of December. The seeds germinate in 10 to 12 days. In the Benares district, in some instances in January, but generally in February and March, the plants are mature, and the capsules fit for scarification. The capsules then become slightly coated over with a fine transparent white bloom, and are less yielding to the touch when pressed. Another method of recognising maturity, is when juice exudes on breaking off the series of stigmata formed on the apex of the capsule. When the plant is in full flower, and just before the time for the fall of the

petals, they are collected in the following manner. The forefinger and thumb encircle the stem just beneath the capsule, and with the other fingers drawn inwards a kind of tube is formed: the fingers are then gently raised, straight over the capsule, and if the petals are matured, they come off. They are never plucked off, as it would injure the capsule. The petals are manufactured into what are technically called *leaves*. A circular ridged earthen plate, about 10 to 14 inches in diameter, is placed over a low fire, some petals are then spread on the heated convex surface, and as soon as their glutinous juice exudes, others are added, and pressed with a damp cloth pad, till they have adhered together. The leaf is then removed and allowed to dry. "Leaves" vary in diameter from 6 to 12 inches, and in thickness from ·3 to ·025 inches.

A few days after removing the petals the capsules are incised. The operation takes place in the afternoon, and is performed by bunches of forked blades (*nashtars*). The blades are bound together with cotton thread, which is at the same time passed between the blades so as to separate the cutting-ends by about $\frac{1}{16}$ inch, while the protrusion of the points is limited to about $\frac{1}{12}$ inch, which thus determines the depth of the incision. The incisions are made vertically* from base to summit, usually along the eminences of the capsule, marking the attachment of the internal dissepiments and penetrating the epicarp and sarcocarp. The number of incisions required to complete the exudation of all the juice varies with size of capsule, from 2 to 6 or even 8; and two to three days are allowed to alternate. A milky juice exudes almost immediately after scarification; the water it contains evaporates slowly, and the outer portion of the tear drying somewhat, thickens a little and acquires a rose-red colour, while the inner portion is semi-fluid and of a pinkish tinge. The collection of the exuded juice takes place early on the morning following the scarification. In Bengal it is performed by a small sheet iron scoop (*sutwa*, सुतवा), which is

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* In some parts of Bengal horizontal incisions are adopted as in Asia Minor. In Mysore thorns are used for scratching the capsules.

twice drawn briskly upwards over each incision, and a finger run over the incisions to close them. The opium thus collected is from time to time emptied into an earthen or brass vessel.

The fresh opium as collected contains about 50 per cent. of moisture. The average quantity yielded per scarification is perhaps 10 grains, while a single healthy plant under favourable circumstances yields about 75 grains opium in from 5 to 8 scarifications. The average yield of opium per bigha obviously varies from year to year. In 1886-87, the average produce in Benares was 5 seers 3 chittacks and 2 katchas and in Bihar 4 seers 5¼ chittacks.

When the vessel containing recently collected semi-fluid opium is tilted and allowed to remain for some time in that position, a blackish fluid having a peculiar odour separates: this is termed *pasewha* (पसेवहा). *Pasewha* is not always found in opium; it is only produced under peculiar atmospheric conditions. It is never present when a strong westerly wind blows, or when no dew is deposited. The yield of opium under these circumstances is small owing to the incision in the capsule being quickly sealed up by the juice, which rapidly concretes, and is entirely free from *pasewha*. Where the deposition of dew on the other hand is considerable, *pasewha* is formed. The *pasewha* present in opium is carefully separated; if allowed to remain, the opium is injured in colour, texture, and aroma, and it becomes unsuited for the China market, although the drug is perfectly pure. Opium containing any amount of *pasewha* is subject to "penalty batta," which consists in a deduction of from $\frac{1}{64}$th to $\frac{5}{64}$ths of the value of the whole weight of opium tendered by the cultivator.

The opium freed partially or completely from *pasewha* is exposed to the air in the shade, and turned occasionally so as not to injure the grain, until it reaches approximately the required consistency, when it is taken to the head or one of the sub-factories, as already described.

The stems and leaves of the poppies are left standing after removal of the capsules, till perfectly dried by the hot winds,

when they are collected and crushed into a coarse powder, termed *trash*, employed for packing opium for the China market.

The opium, as received from the cultivators at the sub-factories, varies in consistence, and is divided into six classes, while the final classification of the drug is determined at the head-factory, where the opium is finally classified in 12 classes. The classification of the drug depends upon the percentage of solid opium present when a sample is dried at 200° F. Thus opium containing 20 per cent. of moisture would be termed opium of 80 degrees consistence. In the classification of opium each class of opium has a range of three degrees. The opium received into the factory may vary in consistence from 81 degrees and upwards to 50 degrees or less, all opium containing only 50 per cent. and under of solid opium being included in one class, called "*Páni-âmez*," while opium above 81 degrees is designated "above *Bála-báshi dar awal*." The assay of opium for moisture is performed by placing 100 grains on a plate, which is placed on a steam table, the opium being constantly rubbed with a spatula till it is reduced to powder. The temperature to which the opium is exposed does not exceed 200° F.

The opium received into the head factory is, after careful examination for adulteration, and assay for moisture, placed in large stone vats, according to the class to which it belongs. The classification of opium is of considerable consequence, because Benares and the Bihar Factory have each to prepare opium for the China market of a fixed consistence, the standard for Bihar being 75 degrees and for Benares 70 degrees consistence: and it is by the admixture of opium of various degrees of consistence that these standards are maintained. Although the standards for the two districts are fixed, a latitude of ·5 of a degree above or below the standard is permitted, as it is practically impossible to exactly hit off the exact standard when manipulating such large quantities of the drug—nearly three tons—as are daily required for caking. In very dry seasons, the opium being of high consistence, a portion may have to

be caked one or more degrees above standard, but under such circumstances the standard weight of opium 1 seer 7½ chittacks must be placed in each cake, no reduction in weight being allowed for increase in consistence. Taking the Benares Agency for example, where the daily manufacture of cakes amount to about 20,000, to cake at one degree above the limit would entail a loss to Government of Rs. 1,260 a day.

The opium received into the head factories is employed for the manufacture of China provision, abkari, and medicinal opium, while at Ghazipur certain varieties are used for the extraction of alkaloids.

To prepare opium for the China market a certain number of vats are selected, and samples assayed for moisture. The contents of those vats which will give when mixed together in certain proportions opium of 69·3 or 69·4 degrees for Benares, are equally distributed over other vats, called alligation vats, the opium is well mixed by men walking about in it and kneading it with their feet and with rakes. The opium is then removed to the caking vats, and is again kneaded on the following morning, when samples from each vat are assayed; should the whole of the assays come out above 69·5° and under 70·50°, the opium is ready for caking.

The manufacture for the China market consists in enveloping a portion of standard opium in leaves agglutinated by a mixture of opium and water called *lewa* (लेवा). *Lewa* consists of dirty but otherwise pure opium broken down in water in which the opium vessels have been washed, and which is technically called *dhoi* (धोई), about 8 per cent. of *pasewha* being added to render the *lewa* glutinous. *Lewa* contains from 52·5 to 53·5 per cent. of solid matter. The opium, leaves, and *lewa* are accurately weighed for each cake.* The finished cake resembles a Dutch cheese in size and shape; it is rolled in a little fine *trash*

* At Benares the following materials are used for making a cake:—Standard opium at 70 degrees, 1 seer 7·5 chittacks; Lewa at 53°, 4·5 chittacks; Leaves, ·5 chittacks; Water, 5 chittacks; *Trash*, ·25 chittacks—Total weight on day of manufacture, 2 seers 1·75 chittacks.

and placed in an earthen cup of the same size as the mould in which it was originally made, and exposed to the sun; this exposure is continued for two or three days, the cakes being constantly turned and carefully examined. One man assisted by a child will turn out about 70 cakes in four hours, though some can turn out 90 to 100. After having dried the cakes partially by exposure to the sun, they are removed, still in thin earthen cups, to the cake godowns, where they are kept on racks, and constantly turned and rubbed with dry *trash*. In September the cakes are finished at the Benares Factory by placing a fine *Chandni* leaf* on each, weighing ·43 of a chittack with ·5 of a chittack of *lewa*. At this period all bulged and grub-eaten shells, &c., are repaired. By October† they are dry to the touch, and are packed in chests, furnished with a double tier of wooden partitions, each tier with twenty square compartments for the reception of as many cakes, the cakes being steadied and lightly packed round with *trash*. All the joins in the box are secured by cloth and pitch, and a cover of coarse canvas sewn on.‡

Abkari opium is the opium prepared for local consumption; it is pure opium dried by exposure to the sun in shallow wooden trays, with constant stirring, until its consistence is 90°; it is then accurately weighed into quantities of one seer, which are pressed into square blocks; the blocks are wrapped in Nipal paper, slightly oiled with poppy oil, and packed in boxes containing 60 cakes.

Medicinal opium is pure opium of good colour and aroma, and free from *pasewha*. It is reduced to powder by being placed on plates which are heated on a steam table, and the

* A person accustomed to handle Indian opium can, by the appearance imparted to a Benares cake by this last leaf, distinguish it from a Patna one.

† Theoretical weight of a Benares cake fit for packing: Standard opium in cake at 70°, 1 seer 7·5 chittacks; Opium in *lewa*, 3 75 chittacks; Leaves, 5·43 chittacks; Fine *trash*, 5 chittacks.

‡ A packed chest of Benares opium weighs 3 maunds 26 seers 1 chittack, and contains 40 cakes, weighing on the average 2 maunds 8 chittacks.

opium constantly rubbed with a steel spatula till a dry powder is obtained.

*Adulteration of Opium.**—The articles used by the cultivator for adulterating opium may be classified as follows:—

1. Adulteration with fresh green parts of the poppy plant, including watery extracts.

2. Adulteration with foreign extractives, and vegetable matter, such as the inspissated juice of the *Opuntia Dillenii* and *Calotropis gigantea,* extracts of the tobacco plant, datura and hemp.

3. Gums and resinous matters. A gum resin derived from different varieties of *Ficus*, and called *Lassa*. The resin of *Shorea robusta* (sál), pulp of Bael fruit, gum from seeds of Talimkhana (*Hygrophylla spinosa*), tamarind pulp, gum from *Acacia arabica*.

4. Farinaceous admixtures, including linseed, poppy seed, seeds of leguminous plants, and esculent tubers and roots. The starchy matter is often heated for a long time before being used; hence iodine reaction may fail.

5. Vegetable substances containing tannin and colouring matters. Catechu, "Gáb" (*Diospyros embryopteris,* juice of fruit), turmeric, flowers of *Bassia latifolia,* betel-nut, extract of pomegranate bark.

6. Saccharine matter; vegetable oils and ghee; soot, charcoal, and semi-burnt opium; cotton and paper; cowdung; earthy and silicious matter; pounded burnt bricks; impure carbonate of soda, &c.

Opium found to be seriously adulterated may be confiscated, or a fine can be levied. At the Benares Agency, during 1868-69, the gross receipt of opium of all kinds amounted to 39,893 maunds, out of which fines were levied on 181 maunds, as being "inferior opium," and on 71 maunds on account of

* Memorandum by the late Surgeon-Major Sheppard, Principal Assistant Opium Agent, Benares.

pasewha, while 31 maunds were confiscated owing to serious adulteration.

MANUFACTURE OF ALKALOIDS.*—The opium used at Ghazipore for manufacture of alkaloids, consists of confiscated opium so adulterated as to be unfit for provision or abkari purposes, adulterated contraband opium and *dhoi*. The average amount of opium used, taking the figures for three years from 1885 to 1888, amounts to about 16,626 lbs. annually.

The yield of alkaloids during 1887-88 was as follows:—

Hydrochlorate of Morphia .	242 lbs.	11½ oz.
Acetate ,, ,, ..	31 ,,	11 ,,
Sulphate ,, ,, ..	19 ,,	10½ ,,
Codeine	30 ,,	10¼ ,,

No narcotine has been manufactured since 1881-82, there being no demand for it. In 1879-80, the yield was 188 lbs.

Morphia is manufactured by the Gregory-Robertson system modified in a few minor details. The opium is steeped in small vats with water, and the liquor passed through blanket filters: the maceration of the residue is repeated until the filtrate is colourless. The mixed filtrates are evaporated by steam to a thin syrupy consistence. Chloride of calcium is then added in the proportion of about 5 per cent. of the weight of the opium used, and the mixture evaporated until it solidifies on cooling. The crystalline magma is then powerfully pressed. The dry cake is dissolved in boiling distilled water, filtered, and the filtrate evaporated until it solidifies on cooling. Pressure is again applied to the magma; and the resulting cake again dissolved in water, and this process is repeated perhaps a dozen times, until the cake is almost white. The expressed mother liquors are again worked up for morphia. The nearly white cake is finally dissolved in boiling distilled water, and ammonia in slight excess added. The precipitate is

* Mr. Gregory, Offg Principal Assistant Opium Agent, Benares, has kindly furnished the information regarding the manufacture, &c., of alkaloids as conducted at Ghazipore.

collected and worked with cold distilled water, until it ceases to give the reaction for chlorides. The precipitated morphia is then neutralized with hydrochloric acid, and the solution crystallised. The crystals are pressed, and mixed with twice their weight of water, and wood charcoal* added in the proportion of 2 oz. to each lb. of the mass. This mixture is heated to 200° F. for about twenty minutes, and then filtered. On cooling the hydrochlorate of morphia separates in crystals. Codeia is obtained from the mother liquor left after the precipitation of the morphia by ammonia. The liquor is concentrated to a moist mass and strongly pressed; the cake is moistened with water and again pressed, and thus is repeated until the alkaloid is nearly white. The cake is broken up in water, and caustic potash added in considerable excess. The codeia separates in crystals slightly coloured. It is finally purified by crystallisation from alcohol. Narcotine is obtained by digesting with hydrochloric acid the insoluble residue left by the action of water on opium: and precipitating with ammonia. The impure narcotine is purified by repeated solution and crystallisation from alcohol, and decolorised by charcoal.

The opium used in Western India is known as Malwa; it is collected in the province of that name, and, besides supplying local markets, is largely exported to China. The following account of the cultivation of the Poppy in Malwa is given by Dr. Impey, who resided there for three years:—"For the successful cultivation of opium, a mild climate, plentiful irrigation, a rich soil, and diligent husbandry, are indispensable. In reference to the first of these, Malwa is placed most favourably. The country is, in general, from 1,800 to 2,000 feet above the level of the sea; the mean temperature is moderate, and range of the thermometer small. Opium is always cultivated in ground near a tank or running stream,

* Charcoal from the *Butea frondosa* is used; it was selected on account of its comparative freedom from saline matter. Though wood charcoal possesses feebler decolorizing power than animal, it had to be used on account of native prejudice against animal charcoal.

so as to be insured at all times of an abundant supply of water. The rich black loam supposed to be produced by the decomposition of trap, and known by the name of cotton soil, is preferred for opium; though fertile and rich enough to produce thirty successive crops of wheat without fallowing, it is not sufficiently rich for the growth of the poppy until well manured; there is, in fact, no crop known to the agriculturist, unless sugar-cane, that requires so much care and labour as the poppy. The ground is first four times ploughed on four successive days, then carefully harrowed, when manure, at the rate of from eight to ten cart-loads an acre, is applied to it; this is scarcely half what is allowed to a turnip crop in Britain. The crop is after this watered once every eight or ten days, the total number of waterings never exceeding nine in all. One bigha takes two days to soak thoroughly in the cold weather, and four as the hot season approaches. Water applied after the petals drop from the flower causes the whole to wither and decay. When the plants are six inches high, they are weeded and thinned, leaving about a foot and a half betwixt each plant; in three months they reach maturity, and are then about four feet in height if well cultivated. The full-grown seed-pod measures three and a half inches vertically, and two and a half in horizontal diameter. Early in February and March the bleeding process commences. Three small lancet-shaped pieces of iron are bound together with cotton, about one-twelfth of an inch alone protruding, so that no discretion as to the depth of the wound to be inflicted shall be left to the operator; and this is drawn sharply up from the top of the stalk at the base to the summit of the pod. Three sets of people are so arranged, that each plant is bled all over once every three or four days, the bleedings being three or four times repeated on each plant. This operation always begins to be performed about three or four o'clock in the afternoon, the hottest part of the day. The juice appears almost immediately on the wound being inflicted, in the shape of a thick, gummy milk, which is soon thickly covered with a brown pellicle. The exudation is greatest over-night, when the incisions are washed and kept

open by the dew. The opium thus derived is scraped off next morning with a blunt iron tool resembling a cleaver in miniature. Here the work of adulteration begins—the scraper being passed heavily over the seed-pod, so as to carry with it a considerable portion of the beard, or pubescence, which contaminates the drug and increases its apparent quantity. The work of scraping begins at dawn, and must be continued till ten o'clock; during this time a workman will collect 7 or 8 ounces of what is called 'chick.'* The drug is next thrown into an earthen vessel, and covered over or drowned in linseed oil at the rate of two parts of oil to one of chick, so as to prevent evaporation. This is the second process of adulteration, the ryot desiring to sell the drug as much drenched with oil as possible, the retailers at the same time refusing to purchase that which is thinner than half-dried glue. One acre of well cultivated ground will yield from 70 to 100 pounds of chick. The price of chick varies from 3 to six rupees a pound, so that an acre will yield from 200 to 600 rupees' worth of opium at one crop. Three pounds of chick will produce about two pounds of opium, from the third to the fifth of the weight being lost in evaporation. It now passes into the hands of the Bunneah, who prepares it and brings it to market. From 25 to 50 pounds having been collected is tied up in parcels in double bags of sheeting cloth, which are suspended from the ceiling so as to avoid air and light, while the spare linseed oi[l] is allowed to drop through. This operation is completed in [a] week or ten days, but the bags are allowed to remain for [a] month or six weeks, during which period the last of the oi[l] which can be separated comes away, the rest probably absorb[s] oxygen and becomes thicker, as in paint. This process occupies from April to June or July, when the rains begin. Th[e] bags are next taken down, and their contents carefully emptie[d] into large vats from 10 to 15 feet in diameter and six or eigh[t] inches deep. Here it is mixed together and worked up wit[h]

* चिक *chick*, a common term in Western India for the sticky juice of any plant.

the hands 5 to 6 hours, until it has acquired an uniform colour and consistence throughout, and become tough and capable of being formed into masses. This process is peculiar to Malwa. It is now made up into balls of from 8 to 10 ounces each, these being thrown, as formed, into a basket full of the chaff of the seed pods. It is next spread on ground previously covered with leaves and stalks of the poppy; here it remains for a week or so, when it is turned over and left to consolidate, until hard enough to bear packing; it is ready for weighing in October or November, and is then sent to market. It is next packed in chests of 150 cakes, the total cost of the manufacture at the place of production being about rupees 14 per chest." The greater part of the opium produced in Malwa is consumed by opium-eaters. Besides linseed oil Malwa opium is often adulterated with starch, and inferior samples with some of the substances already mentioned as used to adulterate opium in Bengal.

Description.—China investment or provision opium varies in colour according to the amount of *pasewha* (पसेवा) present, and the district from which it has been obtained. The colour may vary from dark brown to rich dark chestnut; when viewed in thin layers, it is translucent; odour rich, agreeable, and somewhat fruity; taste hot and bitter. If a small portion be rubbed between the finger and thumb for a few seconds, it draws out into long threads, and from their number, fineness, and tenacity, the Chinese form their first estimate of the value of the drug. The Abkari opium, in square cakes, has a very much darker colour and less pleasant odour than provision opium, its consistence is also greater, and it can with some little difficulty be moulded between the fingers. The medicinal opium occurs as a chocolate coloured finely granular powder.

Malwa opium occurs in round or slightly flattened balls, weighing about ten ounces each, and covered externally with some of the chaff from the capsules; its consistence is about the same as that of average Smyrna opium; appearance of section homogeneous; colour dark brown; odour like that of

Smyrna opium. Poppy capsules as found in Indian commerce are much broken, and appear to have been beaten to extract the seeds, the fragments are marked by triple or quadruple incisions, usually longitudinal, but sometimes transverse. The seeds are reniform, very small, usually white, but sometimes grey, a little over one millimetre long. The testa is composed of six-sided scale-like cells, the albumen is oily, and encloses a curved embryo composed of two cotyledons and a radicle of equal length; the taste is sweet and oily.

Poppy oil is of a pale golden colour, inodorous, of agreeable flavour and soluble in 25 parts of cold and 6 of boiling alcohol. Its chemical constitution is similar to linseed oil; saponification equivalent 290°. Its specific gravity is ·924 to ·927 at 15·5 C.; it solidifies at —18° C.; does not easily become rancid; the oil is present in the seeds to the extent of about 50 per cent., but by the native process much less than this is extracted, the yield under favourable circumstances amounting to about 14 ozs. from 4 lbs. of seed. It is used as a substitute for olive oil by the Military Medical Establishments, but being a drying oil it is not nearly so well suited for medicinal use as the oil of *Arachis hypogæa*. It is also used to adulterate olive oil.

Microscopic structure—Opium of good quality, macerated in glycerine, shows numerous prismatic crystals, some of them in tufted bundles; a few large, refractive globular bodies are seen which have a resinous appearance, and here and there objects which appear to be starch grains; the remainder consists chiefly of amorphous particles, but mixed with them are some fragments of vegetable tissue (epidermis and fibre from the capsules). Of eight kinds of Indian opium examined by Flückiger five contained distinct crystals, two are described as not distinctly crystalline, and of one it is not stated whether it was crystalline or not. His sample of Malwa opium must have been of inferior quality, as the best shows numerous crystals.

Chemical composition.—The alkaloids which have been separated from opium are Hydrocotarnine, $C^{12}H^{15}NO^{3}$;

Morphine, $C^{17} H^{19} NO^{3}$; Pseudomorphine, $C^{17} H^{19} NO^{4}$; Codeine, $C^{18} H^{21} NO^{3}$; Thebaine, $C^{19} H^{21} NO^{3}$; Protopine, $C^{20} H^{19} NO^{5}$; Laudanine, $C^{20} H^{25} NO^{4}$; Codamine, $C^{20} H^{25} NO^{4}$; Papaverine, $C^{20} H^{21} NO^{4}$; Rhœadine, $C^{21} H^{21} NO^{6}$; Opianine, $C^{21} H^{21} NO^{7}$; Meconidine, $C^{21} H^{23} NO^{4}$; Cryptopine, $C^{21} H^{23} NO^{5}$; Laudanosine, $C^{21} H^{27} NO^{4}$; Narcotine, $C^{22} H^{23} NO^{7}$; Lanthopine, $C^{23} H^{25} NO^{4}$; Narceine, $C^{23} H^{29} NO^{9}$; Gnoscopine, $C^{34} H^{36} N^{2} O^{11}$. A bitter principle, Meconin, $C^{10} H^{10} O^{4}$, is also present in opium, accompanied by Meconic acid, $C^{7} H^{4} O^{7}$.

Porphyroxin, first described by Merck, occurs in East Indian, in Smyrna, and probably other opiums. The principle is of interest, because it has the property, of being reddened by hydrochloric acid, a reaction which has been utilized for many years in testing for opium in medico-legal analysis in the Bengal Chemical Examiner's Department. In testing viscera for opium the ethereal extract obtained by Stas's process is evaporated in a porcelain capsule, and the dry residue moistened with dilute hydrochloric acid; on the application of a gentle heat a red coloration is developed should opium be present. A good plan of applying the test is to place on the bottom of the capsule containing the dry ether extract, a very small watch glass moistened with a few drops of concentrated hydrochloric acid, the capsule is then covered with a glass plate; after standing some time a red or violet reddish coloration appears on the sides of the capsule should porphyroxin be present. The application of heat is unnecessary when the test is applied in this manner.* The chemical composition of porphyroxin appears to be a matter of some uncertainty; according to O. Hesse it is a mixture of several distinct principles. Pedler and Warden isolated in 1886 from Bengal opium a neutral principle insoluble in water, but dissolving in ether, chloroform, benzol, &c., and yielding solutions which exhibited a magnificent blue fluorescence. The morphine in opium is combined with meconic

* It is necessary to note that this test is only employed as a corroborative one for the presence of opium

acid. The nature of these two substances was made known by Serturner in 1816, who at the same time pointed out the difference between morphia and narcotine, a substance which had been discovered in opium by Derosne in 1803 and also by Séguin. There can be no doubt that these two chemists also obtained morphine, but failed to distinguish it from narcotine. Warden (*Chem. News*, 38, 146,) has examined the ash of Behar opium. It was of a light grey colour and contained ·857 per cent. of charcoal, which was deducted before calculating the percentage composition, which is as follows:—$Fe^2 O^3$, 1·983; $Ca O$ 7·134; $Mg O$, 2·310; $K^2 O$, 37·240; $Na^2 O$, 1·700; SO^3 23·141; $P^2 O^5$, 10·902; $Si O^2$, 15·274. There were also traces of alumina, manganese, carbon dioxide and chlorine present.

The examinations of various kinds of Indian opium conducted by Dr. Buri in Prof. Flückiger's laboratory (*Pharm. Journ., April* 24, 1875,) gave the following results:—

	Patna garden opium, 1838.	Indian medical opium, 1852.	Abkari provision opium.	Garden Behar opium.	Malwa opium flat cake.	Sind opium.	Hyderabad, Sind.	Khandesh.	Persian, 1872.
a—Ethereal extract, *i.e.* residue dried after the evaporation of the ether	21·2	21·7	22·0	20·6	14·1	17·1	20·4	.	25·0
b—Crude narcotine	10·0	9·0	8·5	7·6	7·6	8·0	9·7	.	10·2
c—Wax difference between *a* & *b*	14·2	12·7	13·5	13·0	6·5	9·4	10·7	.	14·8
d—Purified narcotine	4·0	6·1	5·5	4·5	4·7	3·1	5·4	7·7	6·4
e—Crude morphine	11·2	11·2	14·1	10·6	14·1	–	.	..	...
f—Purified morphine	8·6	4·3	3·5	4·6	6·1	3·8	3·2	6·07	7·1

Professor Fluckiger remarks:—

"The process for the estimation of narcotine and morphine was that described in the *Pharmacographia*, p. 59. The extract *a* of the above table is that afforded by means of boiling ether, with which the powdered opium had almost absolutely been exhausted by repeating the treatment with ether from about twenty to thirty times. The extract remaining after the evaporation of the ether was boiled with acetic acid, 1·04 sp. gr. This

liquid, after the acid had been driven off, yielded *b*, crude narcotine, as a crystalline brownish mass. It was washed with ether, and then afforded *d*, purified narcotine. Under *c* the difference between *a* and *b*, representing the amount of waxy matter, is calculated. It includes also the oily matter, with which the Persian opium is impregnated, as well as a little wax in the case of sample I.

In exhausting the opium with ether, a slightly yellowish fluid is obtained, which displays a bluish fluorescence, due to an unknown constituent of the drug.

Before precipitating the morphine, the aqueous solution was concentrated in order to get a smaller volume.

"It afforded *e*, the crude, dried morphine, which, after twice or three times repeated recrystallization, finally furnished *f*, purified morphine. This purification of morphine cannot be performed without a loss of morphine; the real practical percentage of that alkaloid may therefore more correctly be regarded as somewhat superior to the figure *f*. It would be desirable to apply a process furnishing the exact percentage; yet there is, as far as I know, no such method thoroughly satisfactory. I have been struck with the very large discrepancy, in the Indian opium, of the figures under *e* and *f*, which, I think, is larger than in opium from Asia Minor. Another fact well worth considering is the usually low percentage of morphine of Indian opium, narcotine being frequently present to a larger amount. This has already been pointed out in the *Pharmacographia*, page 57. It would appear, however, that this is of no consequence for the Chinese consumption, yet, possibly, it will be so some day if the home production of the Chinese further increases. Perhaps a more careful preparation of the Indian opium would at least prove of importance, not so much with regard to the smokers of the drug as to the possibility of extracting morphine from Indian opium profitably. It is not needful to point out that this would be highly desirable."

In the following table is shown the analysis of samples of Patna and Behar provision opium, Malwa opium and *pasewha.** These analyses are interesting, as they indicate the amount of extractive obtained by the action of cold and hot water on the drug. The amount of extractive as well as the alkaloidal content varies within narrow limits from year to year. Analyses of Behar and Patna provision opium, arranged as shown in this table, are yearly placed before the merchants at the annual inspection of opium, which takes place before the first sale of the season.—

Variety of Opium	Moisture at 100° C.	Cold-water extract of anhydrous opium at [illegible] C.	Hot water extract of anhydrous opium at 100° C.	Narcotine of anhydrous opium.	Morphia of anhydrous opium.	Total alkaloids.
Behar cake No. 1, manufactured 26th May 1883	26·43	61·25	65·51	5·91	3·80	...
Benares cake No. 1, manufactured 1st January 1883 ...	29·97	63·8	64·57	5·91	4·58	...
Malwa opium, 31st March 1883 ...	8·56	65·90	68·58	6·81	4·92	11·73
Pasewha from Benares District, 1886 ...	19·75	66·31	70·16	5·04	3·19	8·23
Pasewha from Benares District, 1888 ...	22·00	72·05	76·16	4·10	·85	4·95

Regarding the amount of morphia in Malwa opium, according to Dr. Smyttan, formerly Opium Inspector, Bombay, the best Malwa opium yields 8 per cent., Flückiger's analysis gives 14·4 per cent. of crude and 6·1 per cent of purified morphia, a larger yield than that obtained by Mr. Gregory, who only found 4·92 per cent. On the other hand, while Flückiger found only 4·7 per cent of narcotine, the Opium Factory analysis affords 6·81 per cent. Flückiger's analysis of Patna garden opium, in which 8·6 per cent. is given on the content of purified morphia, is an exceptional yield of the alkaloid for

* The analyses of Malwa opium and *pasewha* have been kindly furnished by Mr Gregory of the Benares Agency.

Bengal opium. The analyses of *pasewha* are of special interest as indicating the very wide differences which may occur in its composition.

INDIAN MANUFACTURED ALKALOIDS.—We have examined morphia, codeine and narcotine manufactured at Ghazipore.

The morphia hydrochlorate was in white acicular prisms of silky lustre and free from odour. Dried at 100° C., the crystals lost 12·74 per cent. The hydrochlorate is usually stated to contain three molecules of water, which would be equal to 14·38 per cent. The chlorine calculated as HCl amounted to 9·42 per cent, the sample was consequently deficient in combined acid to the extent of ·3 per cent. The ash amounted to ·063 per cent. By the action of chloroform, ·812 per cent. of extractive was obtained. The precise nature of this extractive was not determined; it probably contained a trace of morphia; it was tested specially for narcotine with negative results. Uncombined morphia to the extent of ·828 per cent. was detected in the sample.

The codeine was a perfectly white powder, and free from odour. Dried at 100° C., it lost 5·16 per cent. The ash amounted to ·056 per cent. The saturating power of the alkaloid for standard acid corresponded closely with that acquired by theory.

The narcotine was in faintly yellowish crystals. It contained only a minute trace of ash, and was free from morphia.*

The following statistics of opium-eating at Balasore, in Orissa, have been collected by Vincent Richards. He says:—"I estimate that about one in every twelve or fourteen of the adult population use the drug; but I believe the habit is somewhat increasing; this increase in the consumption of the drug dates from the famine year, 1866, and is not the result of a growing abuse of it by individual consumers, but of a more

* According to the late Surg.-Major Sheppard, in 1871 the cost of narcotine made at Ghazipore, including every charge, was 8 annas 11 pies per ounce, and the cost of morphia 3 annas per ounce.

extended use of opium amongst the general population. There can be no doubt that opium-eating was greatly resorted to in the famine year, because it mitigated the sufferings arising from hunger and sickness, and enabled the poor people to exist on less food. The number of opium-eaters examined by me was 613, of whom 444 were men and 169 women; of the 444 men, 29 were between 15 and 25 years of age, 87 between 25 and 35 years, 165 between 35 and 45 years, and 163 above 45 years. Thus, by far the greater number were over 35 years of age. Of those above 45 years, 56 were between 45 and 50 years, 74 between 50 and 60 years, and 33 above 60 years. Of the 169 women, 10 were between 15 and 25 years of age, 33 were from 25 to 35 years, 47 from 35 to 45 years, and 79 were above 45 years of age. Here, also, the proportion of those above 35 years is greater. Many were over 50 years of age and not a few 60. *It must be understood that the ages are* not given as exact; they are, however, approximately correct, and arrived at after careful inspection and inquiry. These remarks apply equally to the following, though the periods are not likely to be very inaccurate, as they embrace such a number of years. Not a few mention the famine year (1866) as the time at which they first contracted the habit. Of the men, 274 are said to have taken the drug for from 3 to 10 years, 100 for from 10 to 20 years, 48 from 20 to 30 years, and 22 for more than 30 years. Of the women 104 for from 3 to 10 years, 43 for from 10 to 20 years, 14 from 20 to 30 years, and 8 for more than 30 years. The average ages at which the habit was commenced were amongst the men from 20 to 26 years, and amongst the women from 24 to 30 years. The majority of eaters take their opium twice daily, morning and evening, but not a few in the evening only. Much depends upon the dose, and whether the person has been long addicted to the habit. The well-to-do people mix the drug with water and strain before drinking, but poor people swallow it just as it is sold by the opium vendor. The quantity taken varies from 2 grains to 45 or more daily; but as I shall show large doses are quite the exception, especially amongst

the poorer classes. Of the 444 men, 266 took from 2 to 4 grains daily, 151 from 4 to 12 grains, 18 from 12 to 16 grains, and only 9 more than 16 grains—average 7 grains. Of the 169 women 132 took from 2 to 4 grains, 33 from 4 to 12 grains, and 4 only from 12 to 16 grains; not one took more than 16 grains—average 5 grains. The dose when large has always been gradually increased from the beginning; but it is not at all unusual to find, when the dose is small, that there has been no increase at all. There is not, therefore, that craving for increasing doses, which is generally supposed to exist, nor do the 5 or 7 grains as sold by the vendors represent the actual amount of pure drug, as it is not unfrequently adulterated with catechu and other substances. I think it must be conceded that the foregoing data prove conclusively that excessive use of opium amongst the agricultural classes, and they are the chief consumers in Orissa, is very rare indeed, and that its moderate use may be, and is indulged in for years without producing any decided or appreciable ill effects, except perhaps one to which I shall allude hereafter, though it is a question whether the fact is not rather a blessing from a humanitarian point of view, when we consider how prone destructive agents, such as war, famine, and pestilence are to begin their work of destruction immediately the increase of population proceeds too rapidly." As to the causes which first lead to the use of the drug, they may be summed up as follows:—" Sickness, example, and a belief in its aphrodisiacal powers. The majority are induced to begin the habit through disease, such as fever, elephantiasis, dysentery, colic, rheumatism, and diarrhœa. Some few asserted that they took the drug to enable them the better to undergo fatigue, and to make long journeys. There is one almost inevitable result of a prolonged indulgence in opium-eating, especially if immoderate, namely, a weakening of the procreative powers; in no fewer than 99 cases out of 125 into which I particularly enquired with a view to ascertaining the fact, was this the case; moreover, of the 125 married men, averaging 36 years of age, the average number of children to each

was 1·11 after eleven years of married life. The average dose taken by these men was 14 grs. per diem, and the length of time they had been addicted to the habit 12 years. Opium-eating, at any rate in Balasore, does not conduce to either crime or insanity, since the inhabitants are a particularly law-abiding race, and the insanes are only 0·0069 per cent. of the population."—(*Indian Medical Gazette*, Vol. XII., No. 9, August 1st, 1877.) Our experience of opium-eating in India, though not supported by statistics, leads us to form the same opinion as Vincent Richards with regard to the moderate use of the drug. We believe that excessive indulgence in it is confined to a comparatively small number of people amongst the well-to-do and wealthy classes of the community. More recently (1881), Dr. Moore has published his experience of opium-eating in Rajputana, which supports strongly Richards' opinion.

Opium and all its alkaloids act almost exclusively on the central nervous system, and in mammals especially on the brain, the brain symptoms preponderating in proportion as the organ is developed relatively to the other nerve centres. When taken in small doses there is first a stage of excitement of the circulation, as evidenced by the pulse being fuller and quicker, and by the surface of the skin being warm and flushed. During this stage the individual has the power of directing his energies to any particular object, and the action of the drug causes him to do well whatever he wishes to do. Thus, if he wishes to sleep, and surrounding circumstances be favorable, an agreeable languor followed by quiet sleep comes on. He can be easily aroused from this sleep, and after a few hours the effect passes off, leaving, however, slight headache and languor, with dryness of mouth and slight nausea. If, on the other hand, he wishes to work, he can do this with increased energy; or, if he desires to exert the mind, he will find his imagination more vivid, his thoughts more brilliant, and his power of expression greater (*Christison*.) With moderate doses the stage of excitement is short and is followed by deep sleep, from which the person can still be aroused. The after-effects

are, severe headache, with nausea, furred tongue, and loss of appetite. During the stage of sleep the brain is anæmic, both the arteries and veins being empty. With large doses the first stage is very short. Sleep rapidly follows, becoming deeper and deeper, and passes into coma, from which the patient can no longer be aroused. The pupils become very much contracted, and the pulse from slow and full, becomes feeble. Finally death by asphyxia occurs, the respiration ceasing before the heart. It may occasionally be preceded by convulsions, though this is rare. Upon *post-mortem* examination the ordinary appearances of death by asphyxia are found. (*Lauder Brunton.*)

Although the symptoms which have been narrated are those usually produced by opium, yet in certain individuals the drug provokes quite different phenomena One of the most common is an excessive depression following the sleep produced by moderate doses. The symptoms are a feeling of weakness and prostration, often accompanied by chilliness, dull headache, and giddiness, but especially marked by intense nausea and frequent vomiting. In some cases this condition of depression even replaces the normal second stage. A second and rarer idiosyncrasy towards opium exists in those persons who are rendered by it very delirious, it may be, even wildly so. In certain cases of opium poisoning, convulsions, either partial or complete, have occurred amidst the more usual phenomena. (*Wood.*) In childhood opium is badly borne owing to the preponderance of the brain over the rest of the body and the rapidity with which absorption takes place. Habit enables opium-eaters to take large quantities without danger to life, and in such persons the effects of the drug are very slowly produced, probably owing to a torpid condition of the intestines induced by the habit. Lauder Brunton suggests that the morphine of one dose may be converted in the organism into oxydimorphine, and thus exert an antagonistic action to the next dose. It has been stated that native opium-eaters eat large quantities of sweetmeats to counteract the effects of the drug.

Persons suffering from great pain will bear very large doses of opium; on the other hand, in any disease which interferes with excretion opium requires to be given with great caution.

Of the opium alkaloids morphia is almost purely narcotic. Codeine has a feebly narcotic action, but it greatly lessens the irritability of the nerves of the viscera, both thoracic and abdominal, whence its value in cough and diabetes. Narcotine is nearly related to codeine in its action, and has been largely used in India as an antiperiodic in doses of from 3 to 6 grains. Thebaine approaches strychnia in its action and is an active poison.

In connection with the effects of opium on the system, it is interesting to note that at the Government Opium Factories at Patna and Ghazipore, although men may be immersed above their knees for several hours daily in semi-liquid opium, as in the preparation of *lewa,* that no symptoms of the action of the drug on the system appear to ensue. Again, during the manufacture of opium into cakes for the China market, each cake-maker has as an assistant a boy of from 6 to 12 years of age. By the end of the day's work these children are literally smeared from head to foot with *lewa,* and although the special intolerance of children to opium is well established, cases of toxic symptoms ensuing appear to be unknown. In Patna, and probably also in the Ghazipore district, there is a belief that opium cake-makers are especially exempt from cholera. In certain instances the effects of constantly residing at a sudder opium factory appear to induce a torpid condition of the liver, leading to sub-acute congestion.

Note on Poppy Petals.—The use of poppy petals in the manufacture of the shell of the provision opium cakes has been already referred to; Mr Scott* states that the annual consumption of poppy petals is upwards of 16,000 maunds, for which supply the entire petals of no less than 4,710,400,000 flowers are required. During 1869-70, the sum of £10,235

* "*Manual of Opium Husbandry.*"

was spent by Government for the purchase of leaves (made from petals) for one Opium Agency. The ash yielded by Behar poppy petals has been examined by Warden*; after deduction of carbonic anhydride, sand and charcoal, its composition was as follows:—

Ferric oxide, 3·86; Aluminic oxide, 1·22; Magnesic oxide, 5·60; Calcic oxide, 10·72; Potassic oxide, 41·75; Potassic chloride, 12·28; Sodic chloride, 1·20; Sulphuric anhydride, 3·85; Phosphoric anhydride, 5·61; Silicic anhydride, 13·86.

The capsules and seeds of the poppy are prescribed by native doctors in diarrhœa; the former retain a small quantity of opium. From the seeds is made the Sharáb-i-kashkásh of the Mahometan physicians.†

The Malwa poppy capsules have been analysed by Lyon, of Bombay (1879), who obtained from them ·099 per cent. of alkaloids soluble in ether, consisting apparently of narcotine, ·023 per cent. of impure alkaloids soluble in benzol, and ·033 of impure alkaloids soluble in chloroform. No morphia could be detected in them by the ordinary reagents.

Toxicology.—Opium is chiefly used in India for suicide and infanticide. It is a common practice to swallow oil after the opium, and this is stated to be done by the most determined suicides, who knowing that an attempt will be made to recover them by treatment, have made up their minds to render it fruitless. The belief is that the oil unites with the opium and makes it adhere to the stomach in spite of emetics. Dr. Center remarks that it is possible that the oil might act as a mild laxative which would carry the poison more rapidly from the stomach into the intestines, out of the reach of emetics; while its absorption would go on as well in the latter as in the

* *Chemical News*, xxxix., No 999.

† Take half a maund of poppy seeds, soak them for twenty-four hours in four maunds of water, then bruise the seeds, replace them in the same water and boil down to one-half, rub on a strainer, and add one maund of sugar to the fluid obtained. Compare with Sanb. Comp 73.

former. The quantity of oil taken is often enormous. Opium is also the favourite poison for infanticide. Generally a small quantity is smeared on the nipple and the child allowed to suck. For murder opium is rarely used. During the last ten years only one case has been observed in Bengal and one in the Punjab.

In Bengal the percentage of poisoning by opium in 1880-81, was 35·9 in 270 viscera examined; in 1881-82, 22·6 in 210; in 1882-83, 25·0 in 210; in the remaining nine months of 1883, 19·7 in 126; in 1884, 22·5 in 217; in 1885, 21·3 in 234; in 1886, 19·5 in 266; in 1887, 24·0 in 233.

In the Punjab the percentage was in 1879, 1·8 in 162 viscera examined; in 1880, 0·5 in 194; in 1881, *nil* in 186; in 1882, 1·9 in 201; in 1883, *nil* in 194; in 1884, *nil* in 200; in 1885, *nil* in 234; in 1886, 0·35 in 272; in 1887, *nil* in 228.

In the North-West Provinces and Oudh it is impossible from an examination of the Annual Reports to ascertain the number of human viscera examined during any one year, all the references being classed as "cases," but for the reasons already given, we may assume in the case of opium, that the detections were made in human viscera. The record shows in 1879, 18 detections in 156 cases; in 1880, 18 in 173; in 1881, 18 in 158; in 1882, 19 in 156; in 1883, 12·9 in 177; in 1884, 11 2 in 182; in 1885, 10·7 in 186; in 1886, 8·2 in 170; in 1887, 11·6 in 171.

In the Madras Chemical Examiner's reports we find under the head of "Human Cases, Class A, Viscera examined," that in 1882 opium was detected in 7 out of 152 cases; in 1883, in 9 out of 123 cases; in 1884, in 4 out of 85 cases; in 1885, in 6* out of 81 cases; in 1886, in 2 out of 81 cases; and in 1887, in 1 out of 76 cases. Under the head of "Suspected Attempts to Poison" no detections were made in the articles examined in 1882 and 1883; in 1884, one detection was made in 50 examinations; in 1885, two in 47 examinations; in 1886, four in 47 examinations; and in 1887 none.

* Of these two were morphia.

From the Bombay Chemical Examiner's reports it appears that during the five years ending the 31st of December 1887, the total number of deaths of human beings from poison reported to his office was 225, of which 66 or 29·3 per cent. were from opium. If, however, we take the ten years ending the 31st of December 1887, the figures are—Total deaths 467, of which 98 or 21 per cent. were from opium. The following table gives an analysis of the Bombay cases for the last ten years:—

	Fatal Cases.							Non-Fatal Cases.	Total Cases.
	Children.	Adults.		Total deaths.	Suicide and unknown.	Accident.	Homicide.		
		M.	F.						
1878-79	...	1	5	6	6	...	...	1[1]	7
1879-80	1	5	4	10	8	2[2]	...	...	10
1880-81	...	5	1	6	6	...	..	1	7
1881-82	...	3	6	9	9	..	..	1[3]	10
1882-83	...	...	1	1	1	..	..	1[4]	2
1883	3	7	5	15	12	3[5]	...	2[6]	17
1884	1	3	5	9	8	1[7]	..	...	9
1885	...	9	9	18	18	...	...	2[8]	20
1886	2[9]	5	4	11	10	...	1	1	12
1887	..	7	6	13	13	...	...	1[10]	14
	7	45	46	98	91	6	1	10	108

[1] Detected in a paste on the end of an abortion stick.

[2] One of these in a child aged 2 years. The other a male adult from an overdose of Hydrochlorate of Morphia injected hypodermically.

[3] An attempt at suicide.

[4] In vomit of a man; supposed to have been administered to him in sweetmeat with what motive not stated.

[5] All three children, one clearly accidental, the other two doubtful.

[6] Both attempts at suicide by females.

[7] A boy aged 7 from drinking Kasumba.

[8] In one of these in sweetmeat; in the other opium forwarded for identification. History of case not given.

[9] One of these a case of suicide in a girl aged 13; the other apparently a case of homicide of an infant 2 months old.

[10] Liquor drugged with opium administered by a man to a woman; intent doubtful.

Commerce.—Purchase by Government. All opium is now received by Government on the *challán* or pass system, the *assámiwár*, which we have noticed above, having been abolished. On receipt at the factory it is submitted to examination.

The points that an Opium Examiner keeps before him, and that intuitively pass through his mind, in the physical examination of the drug are:—

(*a*) consistence,
(*b*) colour,
(*c*) texture;
(*d*) aroma.

Each one of the above points gives him some indication as to the quality of the drug and its ultimate appraisement, and also to its disposal for factory uses.

Consistence.—By this term we mean the actual percentage of solid and non-volatile matter in any given sample of the drug, if it were subjected to evaporation and reduced to dryness at a temperature of 200° Fahr.

Pure opium being paid for by Government at a fixed rate for a certain standard of consistence, and being subject to a *pro rata* increase or decrease in price according as it is above or below that standard, it will be readily seen that the importance of arriving at the true consistence of any given parcel of the drug stands second to none of the many duties devolving on the Opium Examiner.

By the help of sensitive balances and metallic tables heated by steam, accurate results in the estimation of consistence can be relied on, and the mechanical method pursued at the present day has already been noticed. Such a delicate operation, however, as the "assaying" of opium, (as the estimation of the true consistence by steam tables is termed), can be

applied to a very limited portion of the many thousand tons of the drug that pass through the factories. Every 100 grains of the drug, therefore, that is placed on the steam table is a representative sample of a large bulk that has been adjudged of nearly equal consistence by the remarkable power of hand estimation practised at the factories, a power that is gained only by years of experience in the examination of the drug.

It would be difficult therefore—nay impossible—to lay down rules for arriving at results that can be satisfactorily obtained only by practice. A few guiding principles will, however, be touched on here.

As a rule the consistence of opium freshly collected from the capsule varies considerably, according to peculiarities of soil and weather, ranging from 30° to 50°, that is, it contains from 30 to 50 per cent. of solid matter.

Between the time of collection, and of weighment and examination of the drug at the Government scales there is generally an interval of from one to even three months, and during this period it is within the power of the cultivator so to manipulate his drug as to raise it to any standard of spissitude. Experience, however, shows that the cultivator is not so easily schooled into turning out an article exactly suitable to the requirements of our factories, and it is no uncommon thing to find in one season two jars lying side by side, one of which contains opium yielding a clean section if cut with a spatula, the other containing a drug so fluid as to be poured out of the jar by tilting it over.

The practical impossibility of guessing with certainty to a degree the consistence of any given sample of opium has given rise to the "classes" of opium now obtaining at the two Agencies. Each class includes in it a range of three degrees of consistence, and between the first and the last class is included all the opium that is ordinarily brought to the Government scales.

The following is the classification table adopted for good opium at the two factories at Patna and Ghazipur, together with the distinctive mark of each class :—

Class.	Distinctive Mark.		Degrees included in each Class.
	At Patna.	At Ghazipur.	
Báshi bála darawal	X	XXX	79, 80, 81
Bála darawal	X	XX	76, 77, 78
Darawal	X	X	73, 74, 75
Awal	I	I	70, 71, 72
Duyum	II	II	67, 68, 69
Siyum	III	III	64, 65, 66
Chaharum	...	IV	61, 62, 63
Panjum	...	V	58, 59, 60
Shishum	...	VI	55, 56, 57
Haftum	...	VII	52, 53, 54

For purposes of district classification the above table answers admirably, and it is also adhered to at the factories when re-classifying by touch the classification of district officers, prior to the ultimate appraisement of the opium by the help of steam tables. During this final classification, however, when the object at the factories is to arrive at the true consistence of every parcel of opium, drug of a spissitude estimated by touch to be above the highest or below the lowest class is assayed separately on the steam table and its true consistence adjudged.

We have thus seen that there are two methods practised at the Agencies for estimating consistence, (*a*) by steam tables, (*b*) by touch. The second is a rough and ready method of assigning into one class masses of opium the true

average consistence of which is finally settled by the first method.

For the determination of consistence which is dependent only on the quantity of moisture contained in the drug the mode of procedure is a simple one and the results satisfactory. In practice, however, disturbing elements are very often introduced, and one of these is *pasewha*. Opium with an admixture of *pasewha* is deceptive to the touch.

In drug free from *pasewha* the granular texture appears to maintain cohesion between the particles which, as it were, support each other and offer a certain amount of resistance to pressure. In drug with a copious admixture of *pasewha* the granular texture is destroyed by the gradual merging of the tears into each other through the medium of the tenaceous and shiny *pasewha*, the cohesion existing is thus lessened, but the tenacity of the drug is increased.

Where the bulk of the produce at the factories lies somewhere intermediate, with regard to the admixture of *pasewha* between the two descriptions of drug given above, the sense of touch is regulated by what comes most in its way. When dealing, therefore, with varieties bordering on the two extremes of the drug we are apt to go astray, and we are thus able to account in a large number of cases for what is known as being "out in parakh" (judgment). We have thus prepared for ourselves an arbitrary and indefinable standard of "touch;" it is, nevertheless, a standard so generally accepted by all examiners of opium in the Agencies that it is practically a fixed one, and it is a recognised maxim that opium entirely free from *pasewha* will assay lower than this our accepted standard of touch, and that opium with a copious admixture of that substance will assay correspondingly higher. A good "parkhia" (examiner) will always, therefore, make due allowance for the absence or presence of *pasewha* in any sample of the drug that is being subjected to examination for consistence. The remarks made here refer entirely to good opium.

Another disturbing element in estimating consistence is heat, particularly on drug charged with *pasewha*. Drug of this character under the influence of heat, undergoes liquefaction to a moderate extent in the process of drying. Opium to be examined for consistence by touch, should invariably be placed, therefore, in shaded and cool verandahs, and the examination should be concluded by 9 or 10 o'clock in the morning, and before the sun gets hot. When, for want of accommodation, jars have to be placed in open yards, their examination should invariably be undertaken first, and in the early morning. The examination by touch, for consistence, of opium that is lying exposed to the sun's rays in the months of April, May, June and July, when all the examination at the factories is conducted, must always be faulty and conjectural, and should never be attempted.

Colour.—The natural colour of the drug runs through infinite shades of brown, from a dull or even bright chestnut to a reddish brown, and from a dark mahogany to a blackish brown. It even appears black at times when viewed in bulk.

These variations are due to causes with which we have no concern here, suffice it to say that they are natural, and to a practised eye easily discernible as the true colours of opium. Age and exposure may darken the colour of the drug but cannot alter its characteristics; and where an alteration appears it may be accepted as a sure indication of adulteration or sophistication of some sort, although, again, sophistication of the drug is possible without any perceptible alteration of colour.

The true colour of opium is clearly seen when the drug is viewed in a very thin film; this is best accomplished by pressing a small portion between two glass slips against the light, or by rubbing it down with the finger on a white earthenware plate. Here it is that we see clearly the various shades of chestnut, reddish brown, dark brown or mahogany, but never black. When rubbed between the fingers opium displays a shining surface and a waxy lustre.

The colour of opium is a valuable indication as to its purity.

Texture.—Like consistence and colour the drug delivered at the Government Factories may be said to differ, one sample from another, in texture. At the two extreme poles of variation there are the distinctly granular, and the perfectly homogeneous, and the bulk of the produce lies, as to texture, somewhere intermediate between those extremes.

The primary causes of variation, into which our enquiry does not extend, are undoubtedly due to differences in soil, and to conditions of weather obtaining at the time of collecting the drug; they are also due, to some extent, to manipulation of the drug after collection. A light-coloured, chestnut or reddish-brown variety of the drug, which is free from *pasewha*, will, as a rule, be found to be distinctly granular, while the dark, or blackish-brown variety, which has more or less of *pasewha* in its composition, or an excess of moisture, will on the other hand tend to the homogeneous type.

Ordinary manipulation, without the aid of sophistication, has little effect on texture, but long-continued manipulation will affect it materially. The presence of *pasewha*, again, affects it in a very marked degree, and so does an excess of moisture.

As already explained under the head "consistence," to the presence of *pasewha* in varying quantities is due the merging, more or less, of the tears into each other whereby the granular nature of the drug passes by imperceptible gradations to the homogeneous. The presence of *pasewha* also alters the dull waxy appearance of the drug to one that is more or less smooth and shiny, adding to it tenacity, and making it more glutinous. Ordinarily, opium, free from *pasewha*, is moderately ductile but the presence of *pasewha*, by adding tenacity, increases also the ductility of the drug. This is seen by drawing out with both hands opium of high consistence. If free from *pasewha* it will be found to be ductile to an extent varying according to consistence, with a uniform and minutely granular texture. When there is *pasewha* present this ductility is increased, while the granular texture is less marked, according

to the proportion of *pasewha* present. The drug when thus drawn out breaks with an irregular fracture; it adheres to the fingers, is viscid and of a plastic nature. The texture of the drug is also well seen in high consistence opium when a section is exposed with a spatula.

Opium of the lower consistences—below about 60°—being in a somewhat fluid state, will not draw out at all but breaks off with ragged edges. Its texture is subject to change, under the same conditions, as in opium of higher consistences.

The texture of any given sample of pure drug is always uniform. A practised eye can at once detect any irregularity, and where such exists it betrays the presence of a foreign substance in the composition of the drug.

Aroma.—Chemistry has not yet isolated the volatile odorous principles of opium. Its aroma, however, is peculiar and characteristic. Some consider it not unpleasant, while others relegate it to the class of disagreeable odours. In well-prepared, fresh drug the aroma is decidedly fruity, but it varies with age, and is even said to vary somewhat with the description of soil on which the plant is grown, and with the manure used.

Careless preparation of the drug, such as its collection or manipulation in plates not scrupulously clean, or allowing it to come in contact with animal substances, such as bladders for storing it away in, or keeping it in ill-ventilated and smoky closets, or shutting it up for security in small, close receptacles, will dissipate and destroy the aroma in drug that is otherwise intrinsically good, and will even give it an offensive odour.

The aroma of the drug is one of its chief commercial criterions, and as such should be carefully guarded by the cultivator. To the Opium Examiner it gives a very important indication as to the suitability of the drug for the various Factory purposes. It is only by chemical tests that the Examiner can be certain that opium that is devoid of aroma or offensive to the smell, although apparently good as to texture and colour, has not also a foreign substance in its composition.

assuming that the foreign substance, if present, has not given the clue by its own specific odour. Under any circumstances, opium deteriorated in its aroma, although it may be otherwise pure, should be set aside, and utilised for other than the main Factory purpose, that is, amalgamation with drug intended for the central mass of cakes, otherwise there will be risk of the deteriorated drug tainting a much larger mass of good opium. (*Gregory.*)

Export.—India exported in 1886, 121,000 cwts. of opium, valued at 1,073 lacs of rupees, in 1887, 132,000 cwts., valued at 1,108 lacs; in 1888, 126,000 cwts., valued at 1,007 lacs.

PAPAVER RHŒAS, *Linn.*

Fig.—*Eng. Bot.* 645; *Bentl. and Trim.*, *t.* 19. Corn Poppy (*Eng.*), Coquelicot (*Fr.*)

Hab.—A weed of cultivation. The capsules.

Vernacular.—Jangli-mudrika (*Bomb.*), Lálá (*Guz.*, *Hind.*).

History, Uses, &c.—There is little to be found in Indian works about this poppy. It is the ῥοιάς of Theophrastus and probably the μήκων ῥοιάς of Dioscorides.* The Khash-khásh-i-Mansúr of the Arabs and Persians may possibly be the same plant; it is described by them as hairy, leaves much divided, capsules small; called Mansur, because it sheds its petals very quickly. In Guzerat and Northern India *P. Rhœas* is grown in gardens, and is called Lálá by the Mahometans, who suppose it to be the Lálá of the Persian poets. The name Mudrika given to the capsules means "stamped with the Mudra or Seal," which is used by Hindus after bathing, and which resembles the capsule in shape. This seal is impressed upon the forehead, both temples, both breasts, both shoulders and the pit of the stomach; that used by the followers of Vishnu is inscribed with the words, "*Shri Narayen,*" and is dipped in Gopichandan, a kind of white clay, and that used by the followers of Shiva bears the word "*Namás Shevaya,*"

* Theoph. Hist. Plant. ix. 13; Dios. iv. 62. Pliny also mentions the Rhœas or wild poppy, 20, 77; 21, 94.

and is dipped in Bhasam (ashes of cowdung). Some of the Swamis, or religious teachers, use a red-hot Mudra to stamp their disciples with. The milky juice of the capsules has a narcotic odour, and slightly sedative properties. Theophrastus says that the herb has the taste of wild endive, and Fée remarks that the peasants of Troves eat the leaves when young.

Description.—The capsules are distinguished by their smooth globular form, those of *P. dubium* being twice as long as broad, and those of *P. hybridum* being bristly.

Chemical composition.—Hesse has obtained from the milky juice a colourless crystallizable substance, Rhœadine, $C^{21}H^{21}NO^6$, of weak alkaline reaction. It is tasteless, not poisonous, nearly insoluble in water, alcohol, ether, chloroform, benzol or aqueous ammonia, but soluble in weak acids; its solution in dilute sulphuric or hydrochloric acid acquires, after a time, a splendid red colour, destroyed by an alkali, but reappearing on addition of an acid. Owing to a statement made by Selmi that the capsules contain an alkaloid similar to morphia, Hesse has again examined them. He says:—"The juice collected in the morning under a clouded sky gave 35 per cent. of dried residue at 100°. The milky juice is at first mostly white; sometimes citron yellow; ferric chloride produces with it a deep red colour, which probably indicates the presence of meconic acid. 4·4 grammes of dry residue gave no trace of morphia, or of a similar alkaloid, 0·090 gramme gave equal to 2·1 per cent. of Rhœadine, and traces of another alkaloid. Rhœadine is not coloured by ferric chloride, but resembles morphia in being almost insoluble in ether." (*Liebig, annalen d. chemie, Vol. clxxxv., p.* 32?.) Attfield, working on a large quantity of material, and by three different processes, failed to detect a trace of morphia in tl   als. (*Pharm. Journ.* (3), *Vol.* 4, *p.* 290.)

ARGEMONE MEXICANA, *Linn.*

Fig.—*Bot. Mag.*, *t.* 243; *Wight, Ill.* ii., *t.* 11. Gamboge Thistle, Mexican Poppy (*Eng.*), Pavot épineux, Chardon bénit (*Fr.*).

Hab.—America. Naturalized in India. The juice of fresh plant, and oil of the seeds.

Vernacular.—Bharbhand, Kutaila or Kutila (*Hind.*), Shiál-kantá (*Beng.*), Datturi (*Can.*), Birama-dándu (*Tam.*), Bramha-dandi-chettu (*Tel.*), Daruri (*Mar.*).

History, Uses, &c.—This is an American plant which has now run wild all over India; it may easily be known by its glaucous prickly thistle-like leaves, bright yellow flowers and yellow milky juice. The latter is used by the natives as an application to ulcers, and in combination with the juice of *Aristolochia bracteata* is given internally in syphilis and gonorrhœa. (*Hove, Tours* in 1787-88; *Bomb. Govt. Records No* 16, *New Series.*) In the Concan the juice with milk is given in leprosy. The seeds and seed oil have been used by European physicians in India, and there has been much difference of opinion regarding their properties, some considering them inert, and others asserting that the oil in doses of from 30 to 60 minims is a valuable remedy in dysentery and other affections of the intestinal canal. The evidence collected in India for the preparation of the Indian Pharmacopœia strongly supports the latter opinion; our experience is also in favour of it; and Charbonnier, who examined the oil in 1868, found it aperient in small doses; possibly those who have used the oil unsuccessfully purchased it in the bazaar, and were supplied with a mixed article; no bazaar-made oils can be relied upon. Further experiments with the oil fully confirm this opinion. Flückiger found 4 to 5 grammes to have a mild purgative effect. The smallness of the dose required to produce an aperient action, and the absence of any disagreeable taste, will probably lead to a more extended use of it as a substitute for castor-oil. An extract made from the whole plant has been found to have an aperient action, and the milky juice to promote the healing of indolent ulcers. We have not noticed any bad effects from its application to the eyes. Its use as an external application to the eyelids in conjunctivitis was probably introduced into this country with the plant by the Portuguese, who appear to

have adopted it in Brazil as a substitute for the Argemone of the Greeks and Romans (*Papaver Argemone*) which was used for that purpose.*

For a similar account of the properties of this plant, as observed in the West Indies by Hamilton, see *Pharmaceutical Journal* [i.], *Vol. IV.*, *p.* 167.

Pouppé Desportes of St. Domingo describes the fresh seeds as emetic and slightly narcotic; he states that the oil obtained from them is used to relieve pain in dry colic.

Description.—The capsules are ¾ to 1½ inch long, terete, bristly, elliptic or oblong, and contain a number of dark brown rugose seeds, rather larger than black mustard. The oil has a bland nutty flavour; when first expressed it is sherry coloured, but becomes, after having been kept for some time, reddish brown.

Chemical composition.—The extract of the whole plant was examined by Haines (1863), who was unable to find any alkaloid in it. Charbonnier (1868) found a small quantity of morphia (?) in the leaves and capsules. The seeds contain in one hundred parts, 36 of oil, 49 of carbohydrates and albumen, 9 of moisture, and 6 of ash. The oil is of a light orange yellow colour and is almost tasteless, it has a specific gravity of about ·920, and remains clear at —8° C.; it dries slowly to a firm jelly, gaining during the process over 8 per cent. of its weight, and then ceases to give the red colour with nitric acid; it is only very slightly soluble in alcohol. The insoluble fatty acids amount to 90 per cent., and melt at 22° C. O. Frolich (1871) obtained from the oil a pretty hard soda soap, and found in the soap liquor, butyric, valerianic, acetic, and a little benzoic acid. According to Fluckiger (1871) the oil has the specific gravity of ·919 at 16·5 C., remains clear at —6 C., dries slowly and incompletely, and is not soluble in 6 volumes of 90 per cent. alcohol, as stated by Charbonnier. Dragendorff has found that the seeds contain an alkaloid

* Dios. ii, 168, 169. Apul. Platonicus de Vir. Herb, 32.

which can be isolated in precisely the same way as morphia, and which agrees with it in all important reactions. As the alkaloid occurs in a very small amount, a sufficient quantity has never been prepared for ultimate analysis. The ash of the seeds is largely composed of alkaline phosphates and sulphates.

Toxicology.—In 1878, a case occurred in Bombay in which a number of people suffered from vomiting and purging after using sweet oil which had been adulterated with Argemone oil. The adulteration may be detected by the rich orange red colour developed when strong nitric acid is added to the oil or to mixtures containing it. In the same year samples of oil were received by the Punjab Chemical Analyser from Amritsar, Simla and other towns which were said to possess irritant properties, causing purging and vomiting. The oil was stated to have been imported from the N.-W. Provinces and to have been made from Siyál-kánta (*Argemone mexicana*).

Commerce.—Occasionally large parcels of the seed are offered for sale, but they are not easily placed, as the oil burns with a very smoky flame.

MECONOPSIS WALLICHII, *Hook.*

Fig.—*Bot. Mag., t.* 4668.

Hab.—Temperate Himalaya.

Description.—*Meconopsis aculeata, Royle, Ill.* 67, t. 15; *Hook. Bot. Mag., t.* 5456, and *M. nepalensis, Dc.*, are reputed to be narcotic, but as O'Shaughnessy gave a drachm of the alcoholic extract of the former plant to a dog without producing any effect, it cannot have very active properties. *M. Wallichii* has been examined by us; it is a large herbaceous plant with tapering roots 6 inches long or more, sometimes bifurcated, 1½ inch or more in diameter, nearly smooth below, but at the upper part very scaly from the remains of leaves round the origin

of the flower stem, which is about 1 inch in diameter and hollow; between the scales are still yellow bristles. The root is brown externally, internally white, soft and spongy, with a large central pith. Odour somewhat musky.

Chemical composition.—The root dried by exposure to air, and reduced to a fine powder, lost 8 per cent. of moisture at 100° C. The ash amounted to 12·7 per cent., and contained a marked amount of manganese. The alkalinity calculated as K H O, after separation of lime, was equal to 8·6 per cent. Digested with light petroleum ether ·48 per cent. of a pale yellow, viscid, transparent, odourless extract was obtained. With the exception of a few white flocks the extract was soluble in absolute alcohol On spontaneous evaporation shining laminæ separated, which under the microscope consisted of rhombic plates and needles: oil globules were also visible. The alcoholic solution of the extract was strongly acid. The amount of crystalline matter was too small to admit of the nature of the fat acid being determined. After exhaustion with light petroleum ether, the powder was dried by exposure to air, and then digested with ether. On evaporating off the ether, ·41 per cent. of a fragrant, soft, indistinctly crystalline residue was left. The extract was heated with dilute hydrochloric acid, and the soft, yellow, insoluble residue separated by filtration. The acid solution was rendered alkaline with ammonia, and then agitated with ether. On separation of the ether only a minute trace of residue was left, which did not respond to alkaloidal reagents. The yellow residue insoluble in H Cl. was treated with ammonia, and the turbid mixture agitated with ether. The ether left on evaporation a yellow, soft, non-crystalline residue, without taste or odour; which had the properties of a neutral resin. The aqueous alkaline solution after the separation of the ether, yielded yellow flocks when treated with dilute acids, which were re-dissolved by alkalies: this principle had the properties of a resin acid. The fragrant odour of the ethereal extract was probably due to a trace of benzoic acid.

After treatment with ether the powder was again dried, and then digested with absolute alcohol. The alcoholic solution was of a pale greenish colour, and possessed a marked greenish-yellow fluorescence; examined spectroscopically no absorption bands were visible. On evaporation, the alcoholic solution yielded 1·07 per cent. of extractive, yellow in colour, and possessing a somewhat fragrant odour. The extract was partly soluble in water. The aqueous solution did not possess any particular taste; it yielded slight precipitates with alkaloidal reagents, with ferric chloride no coloration was produced. On evaporation and ignition a trace of ash was left, possessing an alkaline reaction. The portion of the alcoholic extract insoluble in water, dissolved in alcohol, yielding a greenish solution, with acid reaction, and greenish-yellow fluorescence. The powder, after treatment with alcohol, yielded 12·6 per cent. of extractive to cold water. The aqueous solution was yellowish-brown in colour; alkaline in reaction; it afforded no coloration with ferric chloride; it slightly reduced an alkaline solution of copper on boiling.

FUMARIACEÆ.

FUMARIA OFFICINALIS, *Linn.*

Fig.—*Eng. Bot.*, 589. Common Fumitory (*Eng.*), Fumeterre officinale (*Fr.*).

Hab.—Persia, a weed of cultivation.

Vernacular.—Sháhterah (*Pers.*), Pitpápra, Sháhtera (*Hind.*, *Beng.*, *Bomb.*).

History, Uses, &c.—The Pitpápra imported from Persia does not appear to be *Fumaria parviflora*, as it has a smooth fruit without a double pit at the apex; it is doubtless *F. officinalis*. Several species of Fumitory have long been used medicinally, and were highly esteemed by the Greeks and Romans on account of their diuretic and alterative

properties. Dioscorides calls the plant Κάπνος,* and Pliny derives the name Fumaria from Fumus, smoke, with the explanation that the plant irritates the eyes like smoke; it has also been called *Fumus terræ* with reference to the colour of the foliage, or its smell. Fumitory does not appear to have been mentioned by the early Sanskrit writers. The Arabians and Persians probably derived their knowledge of it from the Greeks, as they hold the same high estimate of its properties. In the Makhzan-el-Adwiya two varieties are mentioned, one with violet-coloured flowers, and a large kind with white flowers; it is described as diuretic and alterative, removing hepatic obstructions, aperient and expellant of the humors, but more especially of atrabilis; two Greek names are given, Kfasúsi and Káfnús; the Arabic names are Baklat-el-malik, and Shahteraj; a corruption from the Persian Shahtereh. In India the drug is still highly esteemed by the Mahometans. Jacquemont on his journey from Calcutta to Delhi observed Fumitory growing abundantly in wheat fields near Chittoor and in the Punjab. He describes it as very near to, if not *F. officinalis*. It was probably *F. parviflora*, which is used in Northern India as Fumitory.

For a European account of the properties and uses of Fumitory, Handschuch "*De plantis Fumariaceis*," may be consulted. Fumitory is laxative and diuretic; it is beneficial in dyspepsia depending upon torpidity of the intestines and in scrofulous skin affections. Dose—2 ounces of the decoction (1 ounce to 1 pint) three times a day.

Description.—The dry plant is generally much broken up; mixed with it are many nearly globular, smooth, indehiscent capsules, the size of a large pin's head and umbilicate at the top; seed single, dark brown, crested, with a depression on one side; odour hardly any; taste bitter, slightly acid and astringent.

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* Dios. 1, 107. Plin. 25, 98, 99. Sibthorp refers the καπνος of Dioscorides to *F. parviflora*, *Lam.*, a plant with white flowers; probably both were used.

Chemical composition.—Fumitory contains—1st, Fumaric acid, $C^4 H^4 O^4$, an acid isomeric with maleic acid, differing from malic acid by containing 1 at. less of water, and from succinic acid by containing 2 at. less of hydrogen; it exists ready formed in several other plants, *viz.*, *Corydalis bulbosa*, *Glaucium flavum*, *Lichen islandicus*, and *Boletus pseudo-ignarius*; it is produced by the dehydration of malic acid, by molecular transformation of maleic acid, namely, when that acid is heated with hydriodic or hydrobromic acid (*Kekulé*, *Ann. ch. Phar.*, *Suppl.* ii, 85), and according to Multhausen (*Ann ch. Phar. ci*, 171), is found among the products of the oxidation of protein compounds by nitro-nitratic acid. (*Watts' Dict. of Chemistry.*)

2nd, Fumarine, an organic base first observed by Peschier (*Liebig, Organische chemie*, p. 633), and more fully examined by Hannon (*J. Chem. Méd.* [3], VIII., 705). The plant gathered while in full flower, contains from 5 to 6 per cent. of this base, to which it appears to owe its specific physiological action. Fumarine is separated from its salts by caustic alkalies or their carbonates in the form of a curdy precipitate; it may be obtained in the crystalline form by spontaneous evaporation of its hot alcoholic solution, but not by evaporation with the aid of heat; the salts have a bitter taste. (*Watts' Dict. of Chemistry.*) According to Preuss, fumarine crystallizes in irregular 6-sided, monoclinic prisms, soluble in alcohol, chloroform, benzol, carbon bisulphide, and amyl-alcohol, sparingly soluble in water, insoluble in ether; its composition has not been determined.

Commerce.—The drug is imported from Persia under the name of Shahterah. Value, about Rs. 4 per Surat maund of 37½ lbs.

The medicinal plants of minor importance belonging to the Fumariaceæ are:—

***Hypecoum procumbens**, *Linn.*, *Schk. Han.* 1, *t.* 27, found in Sind, Afghanistan, and the Punjab salt range. It

appears to be the υπηκόον of Dioscorides, and Hypecoum of Pliny, now known as Cumin cornu or Horned cummin, and like fumitory, a weed of cultivation.

Corydalis Govaniana, *Wall.*, *Royle Ill.*, t. 16, f. 2, a plant of the Western Himalaya, has a yellow juice which is employed medicinally in the treatment of eye diseases like Mámirán. (*Aitchison, Journ. Linn. Soc.* 19, p. 145.) The chemical composition of these plants closely resembles that of Fumaria. They have been used as alteratives, but are of little importance.

CRUCIFERÆ.

ANASTATICA HIEROCHUNTINA, *Linn.*

Fig.—*Jac. Vind.* 1, *t.* 58. Rose of Jericho (*Eng.*), Rose de Jericho (*Fr.*).

Hab.—Syria.

Vernacular.—Kaf Maryam, Kaf Ayesha (*Arab.*), Garbha phúl (*Hind.*, *Guz.*).

History, Uses, &c.—This is a small annual plant growing in sandy wastes in Syria, and is supposed to be the Gurgal, rolling thing, or wheel of Isaiah. There is a tradition that the plant expanded at the birth of the Saviour. Mahometan writers have appropriated this tradition in favour of Ayesha, the favourite wife of the Prophet and mother of the Faithful; the opening of the plant when wetted being considered symbolical of the opening of the womb in child-birth. The branches of Anastatica when in flower, spread out rigidly upon the ground, but when the seed ripens they curl up and form a round ball; this, when placed in water, expands, and the pods after a time open and discharge their seeds; the property of expansion when moist, and closure when dry, is retained for years. There can be little doubt that the dried plant was first introduced into India by the

Mahometans; it is kept in all druggists' shops, and is prescribed in difficult labour, being placed in water until it expands, when the water is administered to the patient. This plant has been supposed by some to be the seed-bearing Amomum of Dioscorides. (*See Primulaceæ.*)

Description.—Stem short and woody, branched in a corymbose manner at the top; leaves obovate, the lower ones entire, the upper remotely toothed; flowers small, yellowish white, forming spikes along the branches; the fruit is a short pouch with a strong curved beak, and two ear-like projections on each side; it is divided into four cells, each cell containing a yellow concavo-convex seed. The whole plant is tomentose, and has hardly any taste; as seen in the shops, it presents the appearance of a little ball of wicker work about the size of a large egg at the top of the unbranched part of the stem.

Commerce.—It is imported from Syria by way of the Persian Gulf.

LEPIDIUM IBERIS, *Linn.*

Fig.—*Lobel. Ic.*, *t.* 223. Peppergrass or Pepperwort (*Eng.*), Passerage ibéride (*Fr.*).

Hab.—Southern Europe to Siberia. The seeds.

Vernacular.—Towdri (*Pers.*).

History, Uses, &c.—These seeds are imported from Persia. In some English books upon Indian Materia Medica they are attributed to *Malva sylvestris*; in others to *Cheiranthus Cheiri*; neither of these suppositions can be correct, as the parcels of seed, when they arrive in Bombay, contain corymbs of small pods, much like those of common Candytuft. Ibn Sina, incorrectly quoting Dioscorides, describes تودري Tozeri as a plant like Farasiyun (πράσιον) with black seeds. (*See Farásiyun.*) Mír Muhammad Husain gives the following account of Towdrí:—"A Persian name, in Greek Arusiman,* in Arabic Bazr-el-khum-khum, Bazr-el-hawah, and Kasisa; at

* ἐρύσιμον of Dios. is generally considered to be *Sisymbrium officinale.*

Ispahan it is called Kadúma; in Kirmán Márdarakht; at Tabriz, Darína. The plant has long leaves, without stalks: the branches are red, stiff and armed with a few prickles; the seed is in a small pod, and of the shape of a lentil, but much smaller; there are three varieties—red, yellow, and white; the latter is the largest. Towdrí is hot in the second degree, and moist in the first, some say dry. Properties aphrodisiac, fattening the body, and purifying the blood." The drug is in general use for the abovementioned properties, which are attributed by the natives to most of the cruciferous seeds. Some of the Towdrí seed is doubtless the produce of *Lepidium Iberis*, *Linn.*, a plant whose habitat extends from Southern Europe to Siberia. This plant was known to the ancients and employed as a rubefacient in rheumatism, &c.; the seeds taken internally were prescribed in bronchitis and dropsy.* According to Pliny they were first used by Damocrates. Coste and Lejanne state that *L. Iberis* is called Cresson de Savane in the Antilles, and is considered to have all the properties of water-cress.

A tea made from *L. ruderale* is used in Russia in intermittent fevers. A rare pepperwort found in some seaside places in Britain.

Description.—All three kinds are similar in shape to the seeds of Candytuft; the so-called white variety is only somewhat paler than the red; a brown-coloured sort is sometimes met with under the name of "Black Towdrí." When soaked in water the seeds become thickly coated with mucilage.

Chemical composition.—Leroux (1837) obtained from the flowering tops and seeds of *Lepidium Iberis* an amorphous bitter principle which he named Lepidin. The plant also yields a sulphuretted volatile oil.

Commerce.—It is imported from Persia. Value, Red, 3½ annas per lb.; White, 5 annas per lb.

* λεπιδίον Dios. ii 165 ἰβηρὶς said by Paulus Ægineta in his Third Book to be same as λεπιδιον. See also Plin 25, 49, App Herb 20. Sibthorp refers λεπιδιον to *L. latifolium*, *L.*, and ἰβηρὶς to *L. graminifolium*, *L.* We may conclude that several species were used.

Dr. Stewart states that in the Punjab and Sind *Matthiola incana, R. Br.*,* is grown for its seeds, which constitute one of the several kinds of "Todri." In short this Persian name appears to have much the same meaning as the λευκοι of the Greeks, being applied loosely to several Spring-flowers. (*See* remarks on *Cheiranthus Cheiri.*)

LEPIDIUM SATIVUM, *Linn.*

Fig.—*Wight, Ill.* ii., 12; *Smith, Fl. Gr.*, *t.* 616. Common Cress (*Eng.*), Cresson (*Fr.*).

Hab.—Cultivated in all countries. The seeds.

Vernacular.—Halif, Halim, Chansur (*Hind.*), Asalio, (*Guz.*), Ahliva (*Mar.*), Ali-virai (*Tam.*), Adeli (*Tel.*).

History, Uses, &c.—The common cress is generally supposed to be a native of Persia, from which country it was probably introduced at an early date into India. The seeds are called Chandrasura in Sanskrit works, and are described as tonic and alterative; water, thickened with the mucilage which they give out, is recommended in the Bhavaprakasa as a remedy for hiccup. The confection of Kabuli containing *ghi* and sugar is used as a restorative tonic, and the seeds are added to purgatives. The Mahometan writers identify cress with the καρδαμον of the Greeks,† and give Habb-el-rashad as the Arabic name for the seeds, which they consider to be hot and dry in the third degree, and to have aphrodisiac and diuretic properties; they recommend them for the dispersion of certain chronic enlargements of the spleen, &c., and as an alterative in various diseased conditions supposed to be produced by cold humours.

Chemical composition.—The herb and seeds of *L. sativum* bruised and macerated and distilled with steam, yield a volatile aromatic oil which does not separate spontaneously from the

* Purple Gillyflower, Eng. Bot., 1935. Quarantaine (*Fr.*)
† Dios. ii., 144; Nasturtium of Pliny, 19, 44; 20, 50. Theoph. H. P. i. 19, vii. 1, 4, 6.

watery distillate, but may be extracted therefrom by agitation with benzene. Three-fourths of the crude product boiled at 226·5°, exhibited the composition of pure a-toluonitril, phenyl-aceto-nitril, or phenyl-methyl cyanide, $C^6 H^5 CH^2 CN$, and when heated to 200° for a short time with hydrochloric acid, yielded phenyl-acetic acid. The same composition is exhibited by the volatile oil of *Tropæolum majus*. *Nasturtium officinale* yields by similar treatment an oil which may be separated from the watery distillate by agitation with light petroleum ether, this solvent being afterwards evaporated off in a paraffin bath at 140°. By fractional distillation of the remaining liquid, an oil was obtained, boiling at 253·5° (261° corr.), and having a specific gravity of 1·0014 at 18°. This oil was found by analysis to have the composition of phenyl-propionitril, $C^6H^5 CH^2CH^2CN$, and on fusing it with potash, decomposing the resulting potassium salt with hydrochloric acid, and extracting with ether, phenyl-propionic acid was obtained in long needles melting at 47°. (*Hofmann.*)

The fatty oil of Cress seeds is described by Schübler as of a brownish yellow colour, sp. gr. 0·924; it thickens and becomes turbid at 6° to 10°, and congeals at 15° to a yellow mass. It has a peculiar smell and taste, and dries slowly.

Commerce.—Cress seeds are imported into Bombay from Persia under the name of Assália. Value, Rs. 3¼ per maund of 37½ lbs.

SISYMBRIUM IRIO, *Linn.*

Fig.—*Eng. Bot.* 1631; *Reich., Ic. Fl Germ., t* 75, *f.* 4408. Hedge Mustard, London Rocket (*Eng.*), Herbe aux Chantres, Tortelle (*Fr.*).

Hab.—Northern India, Persia, Europe. The seeds.

Vernacular.—Khúbkalán (*Hind.*), Khákshi (*Pers., Bomb.*), Rán-tikhi (*Mar.*).

History, Uses, &c.—There is no notice of this drug in the Hindu Materia Medica; it appears to have been intro-

duced into the country by the Mahometans as a substitute for *S. officinale*, the ἐρύσιμον of Dioscorides,* and the Irio of Pliny,† which is reputed to be good for asthma, hoarseness, or any debility of the throat or vocal organs; as also to promote expectoration. In India the seeds are much used in restorative and fattening confections. *S. Irio* was once common about London, and was called London Rocket; it covered the ground in the spring after the great fire of London, and Hallen records that *S. officinale* springs up wherever houses have been burnt. It is a common weed in Persia, and is known by various names in different parts of the country, *e.g.*, in Fars, *Shafterak*, Khorasan, *Khákshí*; Tabriz, *Surdan*; Turkistan, *Shiwaran*; Mazenderan, *Shalumbi*. In Arabic it is called Khubah. Medicinally it is thought to be expectorant, stimulant and restorative; it is also used externally as a stimulating poultice; a large quantity is imported, as it is in constant demand among the Mahometans of India. The plant also grows in Northern India.

Description.—Khákshí is a small red oblong seed about 1-20th of an inch long, one surface is convex, the other grooved, the groove ending in a notch; when placed in water it becomes coated with a transparent mucilage; the cotyledons are yellow and oily. The seed turns rancid if kept for any time; it has a hot flavour like mustard.

Commerce.—It is imported from Persia. Value, Rs. 5 per Surat maund of 37½ lbs.

BRASSICA NIGRA, *Koch.*

Fig.—*Bentley and Trim.*, *t.* 22. Black mustard (*Eng.*), Moutarde noire (*Fr.*). The seeds.

BRASSICA CAMPESTRIS, *Linn.*

Fig.—*Eng. Bot.* 2146. Rape (*Eng.*), Navette, Ravette (*Fr.*). The seeds and oil.

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* Dios. 2, 147; Theophr. H. P. viii. 7.

† Plin. 18, 22; 22, 75. Sibthorp refers ἐρύσιμον to *S. polyceratium, L.*; probably more than one species was used under this name.

BRASSICA JUNCEA, *H. f. and T.*

Fig.—*Jacq. Vind.*, *t.* 171. Indian mustard (*Eng.*), Moutarde rouge (*Fr.*). The seeds.

Hab.—Cultivated universally.

Vernacular—*B. campestris*, Surson (*Hind.*), Sherus (*Mar.*), Sarasava (*Guz.*), Sasave (*Can.*). Other varieties, Rai (*Hind.*, *Guz.*), Kadugu (*Tam.*), Ávélu (*Tel.*), Mohari (*Mar.*).

History, Uses, &c.—One of the Sanskrit names for mustard is Ásuri or "the sorceress," because witches are detected by means of mustard oil. By lamplight several cups are filled with water and the oil dropped in, each cup bears the name of one of the suspected women in the village, and if during the ceremony they observe that the oil takes the form of a woman in any of the cups, they conclude that the person whose name is on that cup is a witch. Mustard is also symbolic of fecundity; in the story of Gul-i-Bakawli, the nymph Bakawli is born again of a peasant woman who had eaten mustard oil extracted from seed grown upon the site of her disappearance. Mustard is mentioned by Greek writers as νάπυ and σίνηπι, and appears to have been used by them as a medicine.* There is reason to suppose that the Romans used it as a condiment and medicine. *Cf.* Pliny 19, 54 and 20, 87, who mentions three varieties. Fée identifies the slender-stemmed mustard of that writer with the *Sinapis alba* of Linnæus, the mustard mentioned as having the leaves of rape he considers to be the *Sinapis nigra*, and that with the leaf of the rocket, the *Sinapis erucoides* of Linnæus. Sanskrit writers call mustard seeds Sarshapa and notice two kinds, sidhartha or white mustard (*B. campestris*), and rajika or brown mustard (probably *B. juncea*). The first kind is almost exclusively used for the production of the expressed oil,† while the brown or black mustards are preferred on account of their greater pungency as rubefacients and for internal administration. The expressed oil of mustard

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* Dios 2, 143.

† Colza and Carcel oil of commerce.

is largely used as an article of diet, and when applied to the skin is considered to keep it soft, cool, and clean, and to promote the growth of hair. In Bengal it is much used by males for rubbing over the body before bathing, females always using cocoanut oil, either plain or perfumed, for the same purpose. Internally the Hindus use mustard combined with other stimulants in dyspepsia and as an emetic; externally they use it in much the same way as we do in Europe, but with the addition of other drugs, most of them of doubtful efficacy. In the Concan the whole seeds, moistened in warm water and sprinkled with lime, are given as a remedy for dyspepsia. In the Makhzan-el-Adwiya three kinds of mustard are noticed. Wild mustard, with small round reddish brown seeds, and two sorts of cultivated mustard, the white and the red. The seeds of the latter are directed to be used for medicinal purposes; they are described as large and not round. The Mahometans consider mustard to be hot and dry, and to have detergent and digestive properties; they prescribe it internally in many diseases in which they think such remedies are indicated; externally they apply it in a variety of ways as a stimulant and counter-irritant. The list of diseases in which it is recommended, and the method of application or administration in each is too long to reproduce here. (*Cf.* Makhzan, article Khardal.) Modern research has shown that essential oil of mustard has antiseptic properties and is destructive of bacteria; it is intensely irritant, and if taken internally would act as a powerful irritant poison. The seeds share its properties, and when powdered and mixed with water act upon the skin and mucous membranes as a stimulant of the circulation, causing heat, redness and pain if the application is short, but vesication and much irritation if too prolonged. It is therefore a most valuable counter-irritant in neuralgic pains and internal congestions. Applied as a hip bath it acts as an indirect emmenagogue by stimulating the circulation. Given internally to the extent of a heaped dessert spoonful in a pint of warm water or gruel, mustard flour acts rapidly as an emetic through its irritant action on the mucous membrane of

the stomach, and is therefore useful when narcotics have been taken in poisonous doses. In small doses mustard flour is carminative and sialagogue, and promotes digestion by increasing the flow of saliva and gastric juice. The seeds act in the same way, but owing to their mucilaginous coating the action is more prolonged and milder. During excretion mustard irritates the kidneys and causes diuresis.

Description.—Four kinds of mustard are generally to be found in the Indian market, namely, *1st*, Karachi mustard, *B. nigra*, var (?)—Globular, of a dark brown colour, surface rough, generally covered with a white pellicle, giving the seeds a grey colour; size about $\frac{1}{16}$ of an inch in diameter.

2nd, *B. nigra*—Seeds globular, dark reddish brown, clean and bright; size about $\frac{1}{15}$ of an inch in diameter; surface rough, but less so than that of the 1st kind.

3rd, *B. juncea*—Seeds oblong, light reddish brown, clean and bright; length $\frac{1}{12}$ of an inch; surface does not appear rough unless magnified.

4th, *B. campestris*—Seeds very slightly oblong, yellow, or reddish brown, clean and bright; diameter $\frac{1}{12}$ of an inch or more; surface smooth to the naked eye, but seen to be finely reticulated under a magnifying glass.

The third kind is preferred by the natives, and may be considered the officinal mustard of India; it has a very bright rich yellow colour when powdered.

Microscopic structure.—The white pellicle which covers the Karachi seeds consists of hexagonal cells. The epidermis of the different kinds of seed consists of one row of closely packed cells, having strong lateral and inner walls; the cells are best seen in the Karachi mustard on account of their greater size.

Chemical composition.—By distilling the seeds (previously macerated) of *B. nigra* and *B. juncea* with water, the pungent

principle, essential oil of mustard is obtained, amounting to ·2 or ·7 per cent., and under certain conditions more from *B. nigra.* This oil, which has the composition $C\,S\,N\,C^3\,H^5$, allyl thiocarbimide, boils at 150°·7 C., has a specific gravity at 0° of 1·036, no rotatory power, and is soluble without coloration or turbidity in three times its weight of cold strong sulphuric acid. The remarkable reaction which gives rise to the formation of mustard oil was explained by Will and Körner in 1863. They obtained from mustard a crystallizable substance, then termed *Myronate of Potassium*, $C^{10}\,H^{18}\,K\,N\,S^2\,O^{10}$, but now known as *Sinnigrin*, from its analogy to *sinalbin*. Sinnigrin when brought into contact with an extract of white mustard or a solution of myrosin, is decomposed into essential oil of mustard, potassium sulphate, and glucose. At the same time a part of the oil is converted into sulphur and crotonitril. (*Roscoe.*) Myrosin is an albumenoid principle contained in white mustard. Its aqueous solution coagulates at 60° C., and then becomes inactive: hence mustard seed which has been roasted yields no volatile oil, nor does it yield any if powdered and introduced at once into boiling water. Sometimes black mustard contains so little myrosin that white mustard has to be added to it in order to develope all the volatile oil it is capable of yielding. Sinalbin is another compound contained in white mustard seed; it is easily soluble in water, less so, in alcohol, and crystallizes in small pearly needles. By the action of myrosin it is converted into sinalbin-mustard-oil, and sulphate of sinapine and glucose. For further information the reader is referred to Roscoe and Schorlemmer's work on Organic Chemistry.

The seeds, roots and herbaceous parts of many of the Cruciferæ yield a volatile oil composed in part of mustard oil and in part of allyl sulphide, $C^6\,H^{10}S$, which is also obtainable from garlic. Many Cruciferæ afford from their roots or seeds chiefly or solely oil of mustard, and from their leaves oil of garlic.

The following percentage analyses of mustard seeds are given by Konig (*Zusamm. d. mensch. Nahrungs, &c., p.* 148) :—

	Description.	Date.	Water	Nitrog. Matters.	Fixed Oil	Myronic Acid	Bitter Salt.	Cellulose	Ash	In dry substance Nitr	In dry substance Oil	By whom examined.
1	.	1864	7.50	18.36 Myrosin + Albumin	26.20	.		.	9.00		28.25	R. Hoffman
2*	Black mustard seed	1876	4.84	29.53	35.70	4.84	3.59	16.70	1.72	5.2	37.62	H. Hassall.
3*	White do	,,	[illegible] 36	27.18	35.76		10.96	16.29	4.11	5.55	37.79	
4*	Do. Yorkshire	1881	9.32	28.57†	21.56			10.52	4.7	4.60	28.19	Press and Stansell.
5*	Do Cambridge.	,,	8.00	28.06†	27.51			8.87	4.70	4.88	29.90	
6*	Black do Cambridge	,,	[illegible] 52	26.50†	25.51	1.69		9.01	4.9[illegible]	4.79	27.92	
	Average		7.20	27.99	29.[illegible]	3.21	(17.66)‡	12.29	4.18	5.11	31.15	

* Containing—	Volatile Oil	Nitrogen.	Sulphur
Mustard Seed No. 2	1.271	5.0[illegible]8	1.[illegible]3
,, ,, 3		5.285	1.224
,, ,, 4	0.06	4.[illegible]	0.9[illegible]
,, ,, 5	0.08	3.49	0.93
,, ,, 6	0.17	4.38	1.28

† Containing Myrosin + Albumin No. 4, 5.24 No. 5, 4.58 No. 6, 5.24 per cent.
‡ Calculated by difference

Mustard seeds submitted to pressure afford about 23 per cent. of a mild-tasting,* inodorous, non-drying oil, solidifying when cooled to —17·5° C., and consisting of the glycerin compound of stearic, oleic and erucic or brassic acid. The last named acid occurs also in rape, and grape seed oils, and is homologous with oleic acid.

The ash constituents of mustard, amounting to 4 per cent., consist chiefly of the phosphates of calcium, magnesium and potassium.

The mustard oil sold in the bazars of India has a pungent odour and bitter taste, owing to the practise of watering the cake before pressing it the second time. It is also said to be largely adulterated in Bengal with poppy seed and other oils. Through the kindness of Mr. Blechenden, Secretary, Agri-Horticultural Society of India, we have had an opportunity of

* When freshly-expressed it has the taste of mustard without the pungency.

examining a specimen of pure mustard oil expressed in a Merce's patent iron mill at the Calcutta Exhibition of 1884. The oil was of a pale yellow colour, with a somewhat nutty and very faintly pungent taste, and faint odour of mustard. At 15°5 C. it had a specific gravity of ·9286. At —9° C. it became as viscid as thick treacle.

The seeds of *B. campestris* yields a brownish-yellow, nearly inodorous and tasteless oil, having when expressed hot, or when long kept, a disagreeable after taste. Sp. gr. about 0·9136. (*Schubler.*) It is the least limpid of the Brassica oils, at —4° it deposits a little fat, and solidifies to a yellow butter at —6°. The cold-pressed oil contains, on the average, 70·32 per cent. carbon, 10·58 hydrogen and 19·10 oxygen; it forms with chlorine a yellow, very viscid compound containing 17·68 per cent. of chlorine, and with bromine a similar compound containing 32·5 per cent. of bromine. *B. campestris* contains myrosin but no sinnigrin.

According to W. J. Smith (*Zeit. Phys. Chem. xii.*, 419), the greater part of the sulpher occurs combined in the glucosidal compound sinnigrin, a smaller quantity occurs not so combined; and in addition there is that which is present as a constituent of albumen. With the germination of cruciferous seeds the glucoside is gradually broken up, but after an interval of several weeks some of it reappears in the leaves of the plant. The rate at which the glucoside in these seeds is broken up in the presence of water was found to vary considerably in different species, and it was further found that the ferment from any cruciferous seed is capable of breaking up the glucoside of any other cruciferous seed. It is therefore inferred that all these seeds contain one and the same ferment, whilst, on the other hand, the glucosides of different species vary considerably in respect to their susceptibility to the ferment.

According to Messrs. Schimmel, the quantity of sulphuretted oil yielded by *Brassica nigra* seeds is 0·90 per cent., and by the seeds of *B. juncea* 0·52 per cent.

Commerce.—Mustard is grown in most parts of India, the price ranges from Rs. 20 to Rs. 40 per candy according to quality and cleanness of seed. Rape is worth about Rs. 7 per cwt.

RAPHANUS SATIVUS, *Linn.*

Fig.— *Lam. Ill., t* 566. Radish (*Eng.*), Radis (*Fr.*).

Vernacular—Mula, Muro (*Bomb.*, *Hind.*), Mullangi (*Tam.*, *Can.*), Mulaka (*Sans.*).

Description.—A large, coarse white radish, is universally cultivated in India. The seeds Bazr-el-fujl (*Arab.*) are used as a diuretic, laxative and lithontriptic; also the juice of the fresh leaves. The root and seeds yield with water a milky distillate, from which a small quantity of oil may be obtained by rectification; it is colourless, heavier than water, and has the taste but not the smell of radishes. The oil contains sulphur; it forms a white precipitate with corrosive sublimate, and yellow with bichloride of platinum. It dissolves with tolerable facility in water.—(*Pless, in Gmelin's Handbook*, X, 56).

The following percentage analyses of Radishes are given by Konig (*Zusamm. d. mensch. Nahrungs., &c., p.* 137).—

When collected.	Water.	Nitr. subs.	Fatty matter.	Sugar.	Non-nitr. extract.	Cellulose.	Ash.	In dry substance. Nitr.	In dry substance. Carbo-Hydr.	By whom examined.
* May 1874	94·31	1·15	0·09	1·11	1·97	0·65	0·67	3·23	51·66	W. Dahlen
† Oct. ,,	93·17	1·15	0·11	0·52	2·80	0·73	0·93	3·55	51·84	W. Dahlen
1876	92·23	1·09	0·26	4·92		0·87	0·6[illegible]	2·24	63·32	R. Pott.
Average	93·34	1·23	0·15	0·88	2·91	0·75	0·71	3·01	56·27	

* It contained Phosphoric acid 0·057, and Sulphur organically combined 0·011 per cent.

† It contained Phosphoric acid 0·090, and Sulphur organically combined 0·023 per cent.

The other Cruciferous plants known in India, which are more or less medicinal, are the following:—

Cheiranthus Cheiri, *Linn.*—The Wallflower is cultivated in Northern India under the name of Todri. This plant and *Matthiola incana* are considered by many to have been the λευκόιον of the Greeks and Viola of the Latins, names which appear to have been rather loosely applied to several Spring flowers. The Germans still call the Wallflower 'Leucoje' and the French know it as Violier as well as Giroflée. Leukoion is described as emmenagogue and deobstruent by Dioscorides, and the Mahometans of India attribute such virtues to the flowers. The seeds contain myrosin and the same oil as *Raphanus sativus*.

Nasturtium officinale, *R. Br.*—The Water-cress is a native of Northern India, and is largely cultivated in many parts of the country. As a salad it has from time immemorial been held in esteem on account of its appetizing and antiscorbutic properties.

Cardamine pratensis, *Linn.*—The Cuckoo-flower or Ladies-smock occurs in Hussora, and has properties similar to *Nasturtium officinale*. The same may be said of the several species of Farsetia which grow in the Punjab.

Eruca sativa, *Lam.*—The Rocket is cultivated in Northern and Central India, and has similar properties, but is more acrid; it is the εὔζωμον (good brothmaker) of the Greeks and Eruca of the Latins. The Arabians call it جر جير (Jarjir) and the Persians ايهقان (Eihukan). The Mahometans say that if a sour Pomegranate is watered with its juice, the fruit will become sweet.

The medicinal action of these Cruciferous plants resembles that of Mustard.

CAPPARIDEÆ.

CLEOME VISCOSA, *Linn.*

Fig.—*Wight Ic.*, t. 2; *Rheede, Hort. Mal.* ix., t. 23. Sticky Cleome (*Eng.*), Herbe puante, Brède puante (*Fr.*).

Hab.—Tropical India and other warm climates. The plant and seeds.

Vernacular.—Hulhúl, Hurhur (*Hind.*), Hurhuria (*Beng.*), Kanphúti, Pivala-tilávana (*Mar.*), Nai-vela (*Tam.*), Kukka-váminta (*Tel.*), Huchu-sasave (*Can.*).

History, Uses, &c.—This common weed on cultivated ground appears to have been long in use in India as a domestic remedy; it is called in Sanskrit Adityabhaktá and Arkakánta. Ainslie says:—"The small compressed, netted surfaced, hottish tasted seeds have got the Tamool name of Nahi Kaddúghoo, or 'dog's mustard,' and are considered by the Vytians as anthelmintic and carminative; they are administered in the quantity of about a tea-spoonful twice daily." The juice of the leaves, Rheede says, "is useful in deafness poured into the ears." This account agrees with the way in which the plant is used at the present time, the juice mixed with oil being a popular remedy for purulent discharges from the ear; hence the name Kánphúti.* It is the *Herbe-puante* or *Brède-puante* of the French Settlements in the East. Descourtilz says that when crushed and applied to the skin it causes much redness and even vesication. Given internally it is sudorific; when cooked it loses its acrid properties. Rumphius gives a similar account of its properties, and says the Portuguese call it Bredo Mamma.

* The juice of plants was used in this way by the Greeks and Romans. Scrib. Larg. Comp. 39. Ad auriculæ et tumorem et dolorem sine ulcere prodest herbæ urceolaris, aut cucurbitæ ramentorum succus tepens per strigilem in foramen auris dolentis infusus.

Description.—An annual weed from 1 to 3 feet high; leaves 3 to 5 foliolate, leaflets obovate, flowers yellow; the whole plant pubescent and extremely viscid; many of the hairs are surmounted by a round gland, from which a reddish viscid secretion exudes; the plant has a powerful odour like black currants. The capsules are from 2 to $3\frac{1}{2}$ inches long, striated, pubescent, tapering towards the point, which is surmounted by the style; the seeds are dark brown or nearly black, reniform, and granular, about the size of black mustard seed; the leaves have a pungent flavour, and the seed a feeble taste of mustard.

GYNANDROPSIS PENTAPHYLLA, *DC.*

Fig.—*Rheede, Hort. Mal. ix. t. 24.*

Hab.—India and all tropical countries. The plant and seeds.

Vernacular.—Hurhur, Húlhúl, Karaila (*Hind.*), Hurhuria (*Beng.*), Vámunta (*Tel.*), Tilávana, Máblí (*Mar.*), Vela, Taivela (*Tam.*), Waila (*Cing.*).

History, Uses, &c.—The five-leaved Cleome, as it was formerly called has been long known as a domestic remedy by the Hindus; it is called in Sanskrit Surjavarta and Arkapushpika, and is noticed by Ainslie, who says, "That the small numerous, warmish kidney formed black seeds, as well as leaves of this plant, are administered in decoction in convulsive affections and typhus fever, to the quantity of half a teacup full twice daily." The natives regard it as having much the same properties as *Cleome viscosa.* In the French colonies and in the Nilgiris it is used as a sudorific. In Pudukota the leaves are applied to boils to prevent the formation of pus. Wight (*Ill. I, p. 34*) says that the bruised leaves are rubefacient and vesicant.

Description.—A common plant on cultivated ground; leaves 5 foliolate, with obovate leaflets; flowers white or

purplish, in glutinous racemes, bracts 3-foliolate; stamens very long, purple; capsules 2 to 4 inches long, tapering towards the point, which is surmounted by the style, striated, pubescent. The whole plant is viscid and covered thickly with glandular hairs; it has a strong peculiar odour like the black currant leaf. The seeds are black, of the same shape and size as those of *Cleome viscosa*, but rougher; they have a very faint flavour of mustard.

Chemical composition.—These plants when crushed in the fresh state develop an acrid volatile oil having the properties of garlic or mustard oil. The dried plants exhausted by alcohol yield a deep green tincture which on evaporation leaves a brown soft resin which has no irritant action when applied to the skin.

CRATÆVA RELGIOSA, *Forst.*, *var. Nurvala.*

Fig.—*Rheede, Hort. Mal iii*, *t.* 12. Holy Garlick Pear (*Eng.*), Tapier (*Fr.*).

Vernacular.—Brarna, Bilasi, Bila (*Hind.*), Barun, Tikoshak (*Beng.*), Maralingam (*Tam.*), Nirvala (*Can.*), Uskia, Urumatti (*Tel.*), Vayavarna, Haravarna, Rámala, Karvan (*Mar.*).

Hab.—Malabar, Canara. Cultivated elsewhere. The leaves and bark.

History, Uses, &c.—This small tree is a native of Malabar and Canara, Tropical Africa, and the Society Islands; it is also found planted about temples and Mahometan tombs in many parts of India. It is worthy of remark that this tree is found planted near tombs in several different parts of the world. The Sanskrit names are Varuna and Asmarighna (lithontriptic). Mr. U. C. Dutt gives the following summary of its properties as described in Sanskrit works:—"It is said to promote the appetite, increase the secretion of the bile, act as a laxative, and remove disorders of the urinary organs. In calculous affections it is used in a great variety of forms, thus a simple decoction of the bark may be given with the

addition of treacle. A compound decoction is prepared along with equal parts of *Tribulus terrestris* and ginger, and is administered with the addition of Yavakshára (impure carbonate of potash) and honey. A compound powder, *Varunádya churna*, is prepared as follows :—A solution of the ashes of *Varuná* is made; this solution is boiled with the addition of the bark in powder and Yavakshára till the water is entirely evaporated, the resulting powder is given in ascites, calculus, enlargements of the abdominal viscera, and affections of the bladder and uterus. A confection, called *Varunádya guda*, is prepared by adding to the fluid extract of the bark, treacle, and a number of diuretic and aromatic substances." The leaves are used as a remedy for swelling of the feet, and a burning sensation in the soles of the feet, a common complaint of a somewhat obscure nature; they are also cooked and eaten as a vegetable to reduce corpulence. The leaf-juice is given in rheumatism in the Concan in doses of ½ to 3 tolas mixed with cocoanut juice and *ghi*. In caries of the bones of the nose the leaf is smoked and the smoke exhaled through the nose. The bark and leaf pounded and tied in a cloth are used as a fomentation in rheumatism. In physiological action this bark resembles Caper bark. (*See next article.*) A tincture has been found to be an excellent emulsifying agent.

Description.—Leaves 3-foliolate, on long petioles, leaflets lanceolate acuminate, thin, smooth, upper surface dark green, under surface of a lighter colour, about 8 inches long and 3 inches broad. When bruised they have a disagreeable smell, something like Hellebore; taste slightly bitter and very pungent, causing a tingling sensation in the tongue, not aromatic. The bark is grey externally, and minutely fissured, thick; fracture short; beneath the grey epidermis is a green layer, substance white; a transverse section shows numerous yellow specks, which when examined with a lens, are seen to be bundles of very large stone cells. The taste is faintly bitter.

Chemical composition.—The bark contains saponin, or a principle similar to it.

CAPPARIS SPINOSA, *Linn.*

Fig.—*Var. 2, rupestris, Sibth., Flor. Græc., t.* 487. *Var. 3, vulgaris, Royle, Illus.* 73. *Var. 4, leucophylla, Deless. Ic. Sel. iii., t.* 10. Caper plant (*Eng.*), Caprier commun (*Fr.*).

Hab.—Europe, Asia, Africa, &c. The bark of the root.

Vernacular.—Kabar (*Arab.*).

History, Uses, &c.—This plant is widely distributed, being found in Afghanistan, West Asia, Europe, North Africa, Australia, and the Sandwich Islands. The common Indian and Oriental form, Var. 3 of Hooker's *Flora of British India* grows on hilly ground in many parts of India. Caper bark does not appear to have been known as a medicine to the Hindus until introduced by the Mahometans, but the fruits of *C. sepiaria, Linn.* (Kákádani), and of *C. aphylla, Roth.* (Karira), are mentioned by Sanskrit writers. Capparis is mentioned by both Greek and Latin writers,* and its medicinal properties were probably made known to the Arabs through them. The Syrian name is Kabár and the Turkish Kabarish, in Persia it is called Kabár and Kárak. The author of the Makhzan-el-Adwiya gives a good description of the plant, and says that the root bark is the most active part, and generally used. He considers it to be hot and dry, and to act as a detergent and astringent, expelling cold humors; it is therefore recommended in palsy, dropsy, and gouty and rheumatic affections, the juice of the fresh plant is directed to be dropped into the ear to kill worms, just as Cleome juice is used in India, all parts of the plant are said to have a stimulating and astringent effect when applied externally. Ainslie mentions the drug as an imported article, and notices its use as an external application to malignant ulcers. The physiological action of Caper bark is very similar to that of Senega, and depends upon the presence in it of a principle similar to, if not identical with, saponin (*see Saponaria Vaccaria*). The

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* Dios. ii., 164 καππαρις or κάππαρι Theophr. H. P. i. 6, iii. 3, vi. 3, 5 vii. 8; Plin. 13, 44; 20, 59 Cels. 4, 9

fresh plant develops a volatile oil having the properties of garlic oil.

Description.—Caper root bark occurs in half quills several inches in length; it is very thick and transversely fissured; the external surface is gray, the internal white, taste bitter and pungent.

Chemical composition.—The root bark, according to Rochleder and Blas, contains a neutral bitter principle of sharp irritating taste, resembling senegin. The flower buds distilled with water yield a distillate having an alliaceous odour. After they have been washed with cold water, hot water extracts from them capric acid ($C^{10}H^{20}O^{2}$), and a gelatinous substance of the pectin group; capric acid is sometimes found deposited on the calices of the buds in white specks having the appearance of wax. (*Watts' Dict. of Chem.*) Forster has isolated a glucoside from the plant which yields, on boiling with sulphuric acid, isodulcite, and a colouring matter similar to quercetin. Similar glucosides were also found in *Sophora japonica* and *Ruta graveolens*. (*Ding. Polytech. Journ.*, 245, 48; *Year-Book Pharm.*, 1883, p. 211.)

Commerce.—The drug is imported *via* the Persian Gulf. Value, Re. ¼ per lb.

The root of **C. zeylanica**, *Linn.*, **C. acuminata**, *Roxb.*, *Vern.* Kálu-kera (*Beng.*), Paliki (*Tel.*), Waghanti (*Mar.*), Govindphal (*Hind.*), Authúndi-kai (*Tam.*), is reputed to be a cooling medicine.

The young shoots of **C. aphylla**, *Roth.*, *Vern.* Karil, and of **C. horrida**, *Linn. f.*, *Vern.* Ardanda, are applied medicinally as a counter-irritant. The unripe fruits of both species are used as a pickle with pepper, mustard and oil. In Padacotta the fruits of **C. grandiflora**, *Wall.*, are pickled; its Tamil name is Killacchedi.

CADABA TRIFOLIATA, *W. & A.*

Fig.—*Hook., Bot. Misc.* 296; *Suppl. t.* 37.

Hab.—Carnatic, Ceylon.

C. INDICA, *Lamk.*

Fig.—*Burm. Ind. t.* 46, *f.* 3.

Hab.—W. Peninsula.

C. FARINOSA, *Forsk.*

Fig.—*Deless., Ic. Sel. iii., t.* 8.

Hab.—Punjab, Sind, Arabia, Africa.

Vernacular.—*C. trifoliata*, Viluthee, Maunthakkooroonthu (*Tam.*); Checkoṇadi (*Tel.*). *C. indica*, Velivi (*Tam.*). *C. farinosa*, Asal, Sarah (*Arab.*).

History, Uses, &c.—The genus derives its title from Kadhab (قضب or قطيب), an Arab name for the *C. rotundifolia* of Forskal, who mentions another species (*C. farinosa*) as medicinal. He says: "Usus antitoxicus: dum rami recentes et minores masticantur, vel pulveris forma eduntur." The latter plant, under the name of سرح is described by Az, from information given to him by an Arab of the desert, as a shrub with a dusty colour, not so tall as the tamarisk (اثل), with small leaves and lank branches or twigs, and always growing slanting. A species of Cadaba is very common in Socotra, and Balfour suggests that the village of Kadhab on the northern shores of that island may have taken its name from this plant, which grows abundantly on the plain in its vicinity.

In Pudukota the root and leaves of *C. indica* are used in decoction as an anthelmintic, and the juice of the leaves of *C. trifoliata* is given to children suffering from indigestion.

According to P. S. Mootooswamy of Tanjore the trifoliate Cadaba is common on the sites of ruined temples and other buildings, and the leaves are considered to be purgative, emmenagogue, antisyphilitic, anthelmintic and antiphlogistic; they are much employed in preparing medicated oils. As a purgative half an ounce of the leaves may be used in decoction like senna with sulphate of magnesia, but the natives usually administer them with myrobalans and ginger; given in this manner they appear to have much the same action as senna. In combination with castor-oil and turmeric the decoction is prescribed by native doctors in amenorrhœa and dysmenorrhœa. The boiled leaves are eaten as an anthelmintic, and are applied externally to rheumatic joints; together with the leaves of *Odina Wodier* and child's urine they are applied as a poultice to phlegmons to promote suppuration. The pods are boiled, dried, soaked in buttermilk, again dried, and fried with melted butter (*ghi*) as a vegetable. The medicinal properties of the root are similar to those of the leaves. *C. trifoliata* is supposed to be the Balaya of Sanskrit writers.

Description:—*C. trifoliata* has palmately 3-foliolate leaves, with oblong or lanceolate leaflets about 2 inches in length. The leaves of *C. indica* are simple ovate or oblong acute or mucronate, from 1 to 1½ inches long. The leaves of *C. farinosa* are hoary, ovate or oblong obtuse and seldom an inch in length.

Chemical composition.—The ethereal and alcoholic extracts of the leaves of *Cadaba indica* yield to acidulated water a somewhat bitter alkaloid giving crystallisable salts when evaporated. No tannin is present, but an organic acid precipitable from a concentrated aqueous extract by an equal volume of alcohol. This acid is combined as a calcium salt, and yields when burnt 21 per cent. of carbonate. Another acid of a dark colour is found in the same extract; it is precipitated by four volumes of spirit, and resembles in some of its reactions cathartic acid.

The leaves contain a considerable quantity of nitrates, recognised by their slight deflagration when burning; and by showing the peculiar ring with the sulphuric acid and iron test even in the cold infusion.

The dried and powdered leaves after complete combustion leave 16·5 per cent. of white ash, of which more than one-half is soluble in water, and consists of alkaline chlorides, carbonates and sulphates.

VIOLACEÆ.

IONIDIUM SUFFRUTICOSUM, *Ging.*

Fig.—*Wight. Ill.*, *t.* 19; *Ic.*, *t.* 308.

Hab.—Tropical Asia, Africa and Australia. The plant.

Vernacular.—Ratanpurs (*Hind.*, *Mar.*), Orilatamaraj (*Tam.*), Purusharatanam (*Tel.*), Nunbora (*Beng.*).

History, Uses, &c.—In Southern India this plant is considered to be one of the two kinds of Chárati mentioned by Sanskrit writers, a synonym for which is Padma-chariní. The native physicians regard it as a tonic and diuretic, and prepare a *paka* or confection of the whole plant. Twenty to sixty grains of the plant are administered in each dose.

Rheede and Ainslie mention Chárati. According to the latter writer, the leaves and tender stalks are demulcent and are used by the natives in decoction and electuary, and also employed in conjunction with some mild oil, in preparing a cooling liniment for the head. The plant is more or less known for its medicinal properties from Agra to Ceylon, and is often used in Southern India as a demulcent in gonorrhœa, and its demulcent properties are known in N. S. Wales, where the plant is common.

Description.—The drug as sold in the shops consists of the root and some of the leafy portion of the plant attached to it; the roots are yellowish-white, 3 to 4 inches in length,

about $\frac{1}{8}$th of inch in diameter at the upper part, gradually tapering downwards, woody and tough, and covered with a corky bark. Stems woody; leaves small, alternate, sub-sessile, lanceolate. Taste mucilaginous.

Chemical composition.—The root contains an alkaloid soluble in ether and alcohol, not easily crystallized; its solution in the form of a salt, which it readily forms with the mineral and vegetable acids, is precipitated by potassio-mercuric iodide, iodine in potassium iodide, tannin and the alkalies. It also contains quercitrin, allied to the viola-quercitrin of Mandelin; and another colouring matter soluble in water, but insoluble in amylic alcohol; an acid resin; and a quantity of mucilage and oxalates.

VIOLA ODORATA, *Linn.*

Fig.—*Bentl. and Trim.*, t. 25. March Violet (*Eng.*), Violette odorante (*Fr.*).

Hab.—The north temperate zone. The plants and flowers.

Vernacular.—Banafshah (*Pers., Hind., Bomb.*).

History, Uses, &c.—The Greeks made use of this herb as a medicine,* and from them and their works the Mahometans probably became acquainted with its properties; it does not appear to have been used by the early Hindu physicians. A long account of its properties will be found in most Arabic and Persian works on Materia Medica; it is generally considered cold and moist, and is especially valued as a diuretic and expectorant, and as a purgative in bilious affections; it is seldom given alone, but is prescribed along with other drugs, which also have an aperient action, such as tamarinds, myrobalans, &c. The diseases in which Banafshah

* Dios. iv. 117 Viola, Latin. digammated from ἴον Plin. 21, 14, 76. Theophrastus H. P. VI., 6; 7, mentions ἴον the flower and ἰωνιά the plant, of which there are two kinds, black and white

is recommended are too numerous to be mentioned here; suffice it to say that they are generally those in which a cooling treatment is thought to be indicated by the hakims. The root has been tried by European medical men in India as a substitute for Ipecacuanha, but according to the Bengal Dispensatory, without satisfactory results. Native doctors consider the purple-flowered variety to be the best; they use the flowers separately, and also the entire plant.

Description.—The root is as thick as a crow quill, very crooked, and furnished with a number of thin radicles; it has a spongy bark, and a hard woody medulullium; the colour is pale yellow; odour and taste not peculiar.

Chemical composition.—The flowers are said to contain, besides colouring matter, slight traces of a volatile oil, three acids, one red and the other colourless, and salicylic acid; an emetic principle called violin, probably identical with emetine; violaquercitrin in close relation to, but not identical with, quercitrin or rutin (*Mandelin*); and sugar, &c. The colouring matter of the flowers is easily turned red by acids, and green by alkalies, and hence the syrup of violets was formerly used as a reagent. The colourless acid called violenic acid by Peretti, is said to crystallize in silky needles, to be soluble in water, alcohol, and ether, and to form yellow salts which stain the skin. According to Boullay, all parts of the plant contain violin. The ash of *V. calaminaris* (yellow violet) growing in Rhenish-Prussia in soil in which zinc is present, has been found to contain that metal.

Commerce.—Violet flowers (Gul-i-Banafshah) and the plant (Kashmiri Banafshah) are the two forms of this drug met with in the Indian markets; the first is generally imported from Persia, and consists of the flowers of the purple violet; the second comes from Cashmere, and is the whole plant in flower; it seems to be a white or yellow flowered variety. In Northern India *Viola cinerea, Boiss.*, and *V. serpens, Wall.*, are used as substitutes for *V. odorata*, and are called Banafsheh.

BIXINEÆ.

GYNOCARDIA ODORATA, *R. Br.*

Fig.—*Bentl. and Trim., t.* 28.

Hab.—Sikkim and Khasia hills to Chittagong, Rangoon and Tenasserim. The seeds.

Vernacular.—Chaulmugra (*Hind., Bomb.*), Tuk-kung (*Lepcha.*).

History, Uses, &c.—We know very little of the history of this drug, but it seems that the inhabitants of South Eastern Asia have for a long time been in the habit of using the seeds of this and of another nearly allied species as a remedy for leprosy. The fruits grow upon the stems and main branches of the tree. The hill tribes in Sikkim use the pulp to poison fish, and after boiling it with water, as a food. The bark is said to be used as a febrifuge; it contains tannin, and its infusion has the odour of essential oil of bitter almonds. There has lately been a demand for it from the Mauritius. Hanbury has pointed out that a seed very similar to Chaulmugra is exported to China from Siam, under the name of *Lukrabo*, and that it differs from Chaulmugra in having a stronger testa. In the Makhzan-el-Adwiya there is a short notice of the seeds under the name of *Chawul mungri*; their use in leprosy and other skin diseases is mentioned both as an internal and external remedy. In native practise the oil is administered mixed with clarified butter; this mixture is of a brownish yellow colour, and of the consistence of a soft ointment; it is often adulterated. Roxburgh, and the authors of the Bengal Dispensatory, briefly notice Chaulmugra, but of late years it has become better known to Europeans, and has been extensively used in many parts of India with a favourable result. In the *Indian Annals of Medical Science*, April, 1856, it was brought to notice as a remedy for secondary syphilis. It was first given as a remedy for phthisis and scrofula by Dr.

R. Jones of Calcutta, in doses of six grains three times a day. In 1868 it was made officinal in the Pharmacopœia of India, where an ointment is directed to be made from the pounded kernels mixed with Ung. Simplex. Within the last few years the oil has been used in several of the London hospitals as a remedy for stiff joints caused by rheumatism, being rubbed in; and also given internally in doses of 3 to 4 minims three times a day after meals; the dose may be gradually increased. For children 1 to 2 minims once a day is sufficient; it may be combined with cod-liver oil. Dr. Young, of Florence, has used the oil with advantage in macular and anæsthetic leprosy; during treatment bronchial affections disappeared. In America it has been used as a remedy for sprains and bruises and for sciatica; over-doses (10 minims three times a day) cause vomiting and purging with loss of appetite, but all people are not equally affected by the drug. In chest affections and phthisis it may be rubbed into the chest with advantage. People taking it should live generously; native Indian doctors recommend abstinence from meat, sweets, spices and acids during its use. Dr. Wyndham Cottle writes to the *British Medical Journal* on Chaulmugra oil and its active principle, Gynocardic acid, as internal and external remedies in various forms of skin disease. Gynocardic acid he finds preferable for several reasons, as it rarely produces nausea, can easily be given in the form of pills, and is more uniform. Both the oil and gynocardic acid are used either as external or internal remedies, the oil being taken best in *perles*; and the oil and the acid best applied as ointments in combination with vaseline. Dr Cottle seems to have found these medicines most serviceable as local applications in eczema. In eczema of the face, and when it shows itself in dry patches, he has found an ointment of gynocardic acid of from 15 to 25 grains to the ounce of vaseline, almost a specific, when most of the ordinary applications in use only served to aggravate the local mischief. The ointment should be applied three or four times daily, so as to keep the affected parts lubricated with it. Again, in eczema of the hands, such an ointment is the most generally useful application with which he is acquainted. In

the acute form of this disease, or where there is much discharge, the good effects following the use of Chaulmugra oil, or gynocardic acid, locally applied, are not so marked. For internal administration it is well to begin with about four minims of the oil, or half a grain of the acid, taken after food, twice or thrice daily, and gradually increased to from half a drachm to one drachm of the oil, or one to three grains of the acid. An aperient should be given at the same time if necessary. The oil may be given in emulsion; it is convenient to have the gynocardic acid made into pills containing half a grain of the acid, with three grains of extract of gentian, extract of hops, or conserve of roses. To commence, one such pill may be given thrice daily. The amount may be gradually increased to three or four pills for each dose. The writer adds that the constitutional effects of the drug may be produced by inunction, and he suggests that a soap in which gynocardic acid was incorporated would probably possess much of the soothing and remedial influences of the gynocardic acid, and prove useful in the treatment of many forms of skin disease.

Description.—The fruit is globular, from 3 to 5 inches in diameter, with a thick hard rough rind, and contains a number of irregularly ovoid seeds in a scanty pulp. The seeds are from 1 to 1¼ inch long, more or less angular or flattened by mutual pressure; they average about 35 grains in weight. The testa is thin, brittle, smooth and of a dull grey colour; the albumen is copious, white when fresh, but brown in the dried seeds and oily, and encloses a pair of large, plain, leafy heart-shaped cotyledons with a stout radicle; the odour of the seed is nauseous and peculiar.

Microscopic structure.—The testa consists of an outer and an inner layer of stone cells placed parallel to the surface of the seed, the space between them being occupied by two or three rows of similar cells, the long axes of which are arranged nearly at right angles to those of the exterior cells. (*Moeller.*) The albumen exhibits large angular cells containing fatty oil, masses of albuminous matter, and tufted crystals. Starch is not present.

Chemical composition.—In the hydraulic press the seeds yield from 25 to 30 per cent. of oil, to ether 51·5 per cent. The oil is sherry-yellow. Sp. gr. ·9450 at 85° F., and turns green with the sulphuric acid test (*cf. Phar. Journ., March* 25, 1876), it deposits in cold weather a quantity of crystalline fat. A chemical examination of the oil, by Moss, has shown that the existence of any alkaloidal substance is doubtful, at least so far as to account for any medicinal efficacy. He finds it to contain a peculiar fatty acid, gynocardic 11·7 per cent., associated with palmitic acid 60·9 per cent., hypogæic acid 4·0 per cent., and cocinic acid 2·3 per cent., in combination with glyceryl as fats, and the two former in the free state as well. Gynocardic acid crystallizes in yellowish plates, melts at 85° F., has an acrid burning taste, probable formula $C^{14} H^{24} O^2$; it strikes a green colour with sulphuric acid. Moss also found that palm oil gave a similar reaction. The chemistry of Chaulmugra has recently (1885) been investigated by E. Heckel and F. Schlagdenhauffen, who consider the following test to be characteristic of the oil. They direct the oil to be mixed with an ethereal solution of ferric chloride, and the mixture to be evaporated until the oil becomes of a dirty green colour; it is then allowed to cool, and a few drops of sulphuric acid are added, which produce a fine greenish-blue colour. The colouring matter may be dissolved out by chloroform, with which it forms a dichroic solution like that of chlorophyll. This solution gives a deep absorption band extending from 40° to 70° of the scale (the sodium-ray coinciding with 50°). In proportion as the solution is diluted the black band becomes fainter, until, with a very weak solution, only a narrow very pale band can be seen, extending between 40° and 48° of the scale.

The following is the result of the analysis of the seeds:—

Soluble in water	9·175	Glucose..................	0· 50
		Fixed salts.....	1· 114
		Albumenoid matters...	1·2675
		Colouring matters, &c.	6·2935

Fatty matters soluble in Petroleum	30·120	....	30·120
Fatty matters soluble in Chloroform ...	0·505	....	0·505
Soluble in methylic alcohol..............	5·405	Glucose..................	0·54
		Albumenoid matters...	0·4206
		Fixed salts..............	0·090
		Non-nitrogenized organic matters......	4·3544
Residue insoluble in methylic alcohol.	49·009	Albumenoid matters.	23·8740
		Fixed salts............ ..	4·845
		Cellulose and other non-nitrogenized matters...........	20·290
Moisture..................	5·786		
	100·000		

—(*Journ. de Phar. et de Chim.*, *April* 1*st*, 1885.)

Commerce.—The seeds are collected in the Lower Himalayas in December and are brought to Calcutta. Value about Rs. 12 per Bengal maund of 80 lbs. Of late years a false Chaulmugra seed has occasionally found its way to India. It has a thicker shell and yields less oil.

False Chaulmugra, Lukrabo or Ta-Fung-Tsze.—The following article by Mr. E. M. Holmes appeared in the *Pharm. Journal*, 3rd Ser. XV., 41:—"In the interesting papers on 'Chinese Materia Medica,' by the late Daniel Hanbury, published in the *Pharmaceutical Journal* [2], Vol. III., a seed is described and illustrated under the name of *ta-fung-tsze*, which he conjectured to be allied to *chaulmugra*. This seed is largely used in China in skin diseases and leprosy, and is said to have been employed in that country for at least 300 years, since the tree affording the seed is figured in the old Chinese herbal 'Puntsaou,' published A. D. 1596. The tree, however, has up to the present time been unknown to botanists. The *ta-fung-tsze* is still an article of considerable commerce, figuring in the Consular Blue-Books under Chinese imports by the

name of *lukrabo*. As much as 48 piculs (6,400 lbs.) of the seed were exported from Bankok to China in 1871. It is also exported thither from Saigon, in Cochin-China. The seed in question is about half the length of *chaulmugra* seed, but of equal diameter. The shell is thicker and harder, and at one end is marked with a few radiating slightly raised ridges, whereas that of *chaulmugra* is quite smooth.

"Dr. Porter Smith, in his 'Chinese Materia Medica' (1871), p. 140, describes these seeds under the name of *lucrubau*, and he also considers them as a variety of *chaulmugra*. He states that they are described in Chinese books as being good for leprosy, lepra, itch, pityriasis, psoriasis, syphilis, lipoma, vermes, and chaps on the back of the hands, and that calomel and the seeds of *Robinia amara* are used with the lucrubau, both externally and internally, in the treatment of leprosy. In the province of Hupeh the seeds are in great repute as a remedy for parasitic pediculi and the itch insect. In Soubeiran's "Matière Médicale chez les Chinois" (p 221), the seeds are erroneously referred to *Gynocardia odorata*.

"In the Kew Report 1878, p. 30, the seeds under the name of *dai-phong-tu*, are said to be used in Saigon as a vermifuge after the extraction of the oil. It is added that M. Pierre has successfully raised some seeds of the plant, and refers it to the genus *Hydnocarpus*. The species, however, is not mentioned in the Kew Report, and no further information has appeared in it upon this point in subsequent years. Having had a specimen of the *lukrabo* seed in the Museum of the Pharmaceutical Society for some years—without a specific name—the author recently wrote to M. Pierre for information as to the species yielding the seed. In response that gentleman forwarded for the Society's herbarium a specimen of the plant with flowers and seeds, and the following interesting statement:—"It is a new species, which I have named *Hydnocarpus anthelmintica*, *Pierre*. It is very nearly allied to *H. alpina*, *Wight*, p. 940, but its leaves are more

linear-oblong. The scales opposite to the petals are less long and more ciliated, the stigma is furrowed in its whole extent, and is only toothed towards the extremity of its reflexed margin, while in *H. alpina* it is furnished with large lobes. The male-flower contains a rudimentary ovary; in the female flower this is pyramidal. The seeds are used as a vermifuge by the Annamites. The names given in Annam to the plant are *dai-phong-tu* and *thuoc-phu-tu*. The specimen sent was gathered in the province of Bien Hoa, in Southern Cochin-China."

HYDNOCARPUS WIGHTIANA, *Blume.*

Fig.—*Wight, Ill. i., t.* 16; *Rheede, Hort Mal. i., t.* 36. Jungle almond (*Eng.*).

Hab.—Western Peninsula, South Concan to Travancore. The seeds.

Vernacular.—Kadu-kavatha (*Mar.*), Niradimutu (*Tam.*), Niradivittulu (*Tel.*), Tamana, Maravetti (*Mal.*).

History, Uses, &c.—All that we know of the history of this tree is that the seeds have long been used as a domestic remedy upon the Western Coast in certain obstinate skin diseases, and that the oil is expressed by the poorer classes for burning, and for use as a medicine. In scabby eruptions the oil mixed with an equal portion of *Jatropha Curcas* oil, sulphur, camphor and limejuice, is rubbed in. For scald head equal parts of the oil and lime-water are used as a liniment. The oil has also a reputation in the Concan as a remedy for *Bursati* in horses. Rheede tells us that it relieves rheumatic pains, is used in skin diseases, and mixed with ashes is applied to abscesses, sore eyes and wounds infected with maggots. (*Hort. Mal. i.*, 36.) In Travancore half-teaspoonful doses are given in leprous affections, and it is beaten up with the kernels and shells of castor seeds as a remedy for itch. Latterly the oil has been brought to the notice of

Europeans as a substitute for Chaulmugra, and has been used in the Bombay Presidency with satisfactory results.

Description.—The fruit is globose, about the size of an apple; it has a rough, thick, brown rind, externally suberous, internally woody, which is generally studded with large tubercles, but non-tubercular fruit may be found on most trees. Within are from ten to twenty obtusely angular seeds, ¾ of an inch in length, embedded in a scanty white pulp firmly adherent to the thin black testa. When the pulp is scraped off, the outer surface of the testa is seen to be rough and striated by shallow longitudinal grooves; it has not the prominent ridges of *H. venenata*, *Gartn. Fruct.* i., *t.* 60. Inside the shell is a copious oily albumen, containing two large, plain, heart-shaped, leafy cotyledons like those of Chaulmugra. The albumen, when fresh is white, but turns of a dark brown colour in the dry seeds; the odour resembles that of Chaulmugra.

Microscopic structure.—The testa and albumen present the same appearance as those of the Chaulmugra seed.

Chemical composition.—The seeds contain about 44 per cent. of oil, which has an odour and colour similar to that of Chaulmugra oil; and a sp. gr. of 85° F. of ·9482. A large quantity in stock for more than 12 months did not give any crystalline fatty deposit. Treated with sulphuric acid the oil affords the gynocardic acid reaction, but in a less degree than Chaulmugra.

Commerce.—The seeds are not an article of trade, but if ordered, may be obtained at about half the price of those of Chaulmugra. The oil has been sold in Madras at As. 2-6 per seer.

BIXA ORELLANA, *Linn.*

Fig.—*Rumph., Amb II.*, 19; *Bot. Mag.* 1456. Annatto bush (*Eng.*), Rocouyer (*Fr.*).

Hab.—America. Cultivated in India.

Vernacular.—Sendri, Kesri, Kesar-bondi (*Mar.*), Nutkaner (*Beng.*).

History, Uses, &c.—Bixa is the name given to this shrub by the American Indians; the Brazilian name is Urucuara, or the Urucu plant, Urucu being the Brazilian name for the pigment. There are two varieties, one with pink flowers and greenish-yellow fruit.

The plant does not thrive without plenty of sun.

The pigment is prepared by macerating the seeds in water, straining to remove seeds and evaporating to a suitable consistence; the mass is then made into *roll* or *flag Annatto.* The seeds simply dried with the pigment on them are called *Urucu em gros.* Urucu is used by the American Indians as a dye and for colouring food. A hot infusion of the leaves is considered to be a remedy for jaundice. (*U. S. A. Consul's Rep. on Annatto.*)[4] Annatto is also used by Caribs to dye their bodies; and in Europe to colour butter, cheese and varnish. The use of annatto in dyeing cloth is now limited, *aurin*, an aniline dye, being used for the production of orange colours.

The pulp surrounding the seeds is astringent and slightly purgative. (*Roxb.*) The seeds and root are cordial, astringent and febrifuge. (*Rumph.*) The plant thrives in India and is cultivated in many parts of the country. It is the Galuga of Rumphius (II. 28), who notices its use in Amboyna as a paint and dye.

Chemical composition.—The colouring matter contained in the seeds may be obtained in the form of minute red leaflets (Bixin C^{28} H^{34} O^{5}) insoluble in water, slightly soluble in alcohol, but easily dissolved by ether.

Bixin dissolves in concentrated sulphuric acid, the solution being of a bright blue colour; diluted with water it yields a green precipitate.

COCHLOSPERMUM GOSSYPIUM, *DC.*

Fig.—*Wight in Hook. Bot. Misc. ii.*, 357; *Suppl.*, t. 18. Golden Silk-cotton tree (*Eng.*).

Hab.—Garwhal, Bundelkhund, Behar, Orissa and Deccan. The gum.

Vernacular.—The tree, Pili-kapas (*Hind.*), Tanaku (*Tam.*), Konda-gogu (*Tel.*). The gum, Katíra-i-Hindi (*Pers.*, *Hind.*).

History, Uses, &c.—This tree grows upon dry hilly ground, where it attains a large size. The flowers are large and of a golden yellow colour, and appear in March and April, when the tree is destitute of leaves; the capsule is the size of a goose egg and filled with cotton; the seeds kidney-shaped or cochleate, with a hard testa. The gum is used in the Upper Provinces as a substitute for Tragacanth. The Katíra, or more correctly Kathíra of Arabic and Persian writers on Materia Medica, is the true Tragacanth, and the name has been transferred to the gum of this tree by the Mahometan settlers in India. In Colebe the seeds are roasted and eaten; they are sweet and oily; the young leaves are used to make a cooling wash for the hair. (*Rumph.*, I. 80.) In Bombay the gum of *Sterculia urens*, called 'Karai gond' by the Guzerathi shopkeepers, is used as country Tragacanth, and is sold by Mussalman druggists as Katíra.

Description.—White or yellowish, generally in large vermicular pieces, transversely fissured, and showing a tendency to split up into flat scales, sometimes in large flat pieces like Tragacanth; when moistened it swells up into a bulky transparent jelly, which may be diffused in a large quantity of water, but is only very sparingly soluble. Its solution in water is neutral; the portion insoluble in water yields with alkalies a thick mucilage of a pinkish colour, which, according to Mitchell (1880), is not precipitated by acids.

FLACOURTIA CATAPHRACTA, *Roxb.*

Fig.—*Rumph. Amb., Cap.* 43, *p.* 38; *XIX., t.* 1, 2. Many-spined Flacourtia (*Eng.*), Prunier d' Inde (*Fr.*).

Hab.—India. Commonly cultivated. The fruit.

Vernacular.—Pani-aonvala (*Hind.*), Jaggam (*Port.*), Tambat (*Mar.*), Paniála (*Beng.*).

History, Uses, &c.—This is the Práchinámalaka of Sanskrit writers; it appears to be doubtful whether it is a native of India, as it is generally met with in a cultivated state. The author of the Makhzan-el-Adwiya speaks of two kinds of Paniála, one cultivated and the other wild. He describes the fruit as being like a plum, but differing from it in having 5 to 6 stones instead of one, and suggests that this difference may be due to the impurity of the atmosphere of Bengal operating upon the plum tree of Persia. The Bombay name Jaggam appears to be a corruption of Jangomas. Dalzell and Gibson consider the tree to be truly wild in the Southern Concan. The fruit is recommended as useful in bilious conditions; and like most acid fruits, it no doubt relieves the nausea and checks purging. It is the size of a plum, purple, and acid; indehiscent, with a hard endocarp; seeds 5 to 6, obovoid; testa coriaceous; cotyledons orbicular.

F. Ramontchi, *L'Herit.*, the Mauritius plum, and *F. sepiaria*, *Roxb.*, have similar properties. None of these plants are of any importance medicinally, nor are they worth cultivating as fruit trees. Their bark and leaves are acid and astringent, and are sometimes used by the natives both internally and externally. The leaves of *F. Cataphracta* are oblong or oblong-lanceolate, long-acuminate, glabrous, crenate-serrate, 2—4 by 1—1¾ inches; they have a short petiole from ¼ to ½ an inch in length. An oil is extracted from the seeds on the Malabar Coast.

PITTOSPOREÆ.

PITTOSPORUM FLORIBUNDUM,

W. & A. var.

Hab.—Subtropical Himalaya, Western Peninsula.

Vernacular.—Vehkali, Vikhári, Vehyenti (*Mar.*), Tibiliti (*Nepal.*).

History, Uses, &c.—Little or nothing appears to be known of the medicinal properties of the genus Pittosporum. A variety of *P. floribundum* is common on the Western ghauts and in other mountainous parts of India. The bark is bitter and aromatic, and is said by the natives to possess narcotic properties. It is used as a febrifuge in doses of 5—10 grains; in doses of 20 grains they believe it to be a specific for snake poison. The Marathas on the Ghats call it Vikhari or Vishári, which means "an antidote for poison." Mr. Bajaba Balaji Nené, a Brahmin practitioner of Poona, who first noticed its use among the hill people, informs us that he has given 5—10 grain doses of the dried bark with benefit in chronic bronchitis, and that he finds it to be a good expectorant, but in one or two cases in which it was tried in Bombay, it is said to have given rise to dysenteric symptoms; Mr. Nené, however, informs us that he has not observed its administration to be followed by any such effect. Graham remarks that the cortex fetidus of Rumphius (vii., 7,) appears to belong to this genus.

Description.—The bark is in single hard quills of various sizes, the external surface is grey and marked by numerous transverse ellipsoid warty prominences, which often form circular rings; the inner surface is very smooth and of a light brown colour when dry; fracture short, granular; odour aromatic and resembling that of caraways; taste sub-aromatic and very bitter. *P. floribundum* is a small tree, branches

often umbelled; leaves lanceolate or oblong-lanceolate, acute or acuminate, margins waved 2—8 by 1—3 inches, glabrous, shining, pale below, coriaceous. Corymbs terminal, branches 1—3 inches, spreading, glabrous or pubescent. Flowers few or numerous, yellow; sepals obtuse or acute, subciliate; style glabrous. Capsules size of a large pea, glabrous, about 6-seeded, opening round the apex; seeds covered with a reddish resinous substance. Graham considers the *P. floribundum* of Western India to be very near to if not identical with *P. undulatum*, *Vent.* of N. S. Wales, called by the English colonists Native Laurel and Mock Orange, from the bark of which Baron Mueller and L. Rummel have obtained a bitter glucoside which they have named Pittosporin. (*Cf. Wittstein: Org. Const. of Plants.*) The Indian plant yields a similar principle, as well as an aromatic yellow resin or oleo-resin having very tenacious properties.

POLYGALEÆ

A plant named πολυγάλον was known to the Greeks and Romans, and is mentioned by Dioscorides and Pliny; it is generally identified with the *Polygala vulgaris*, *Linn.*, the Milkwort of the English and Laitier of the French. Dodoneus calls it "*Flos ambarvallis*," or, "the flower which goes round the fields," because, says Gerarde, "it doth especially floure in the Crosse or Gang weeke, or Rogation weeke; of which floures the maidens which use in the countries to walk the Procession, do make themselves garlands and nosegays; in English we may call it Crosse-floure, or Procession-floure, Gang-floure, Rogation-floure, and Milkwort." *P. vulgaris* is bitter, acrid, and somewhat aromatic, especially the root; it acts as an expectorant, tonic, and purgative, and still retains a reputation in Europe as an expectorant in chronic bronchial catarrh. Several species of Polygala are used on account of their possessing similar medicinal properties, the best known being the *P. Senega* of America. In the East *P. tenuifolia* is the Yuen-chi of the Chinese. Smith (*Chinese Mat. Med.*, p. 175)

says that the root is brought from Shensi and Honan, and is used in cynanche, cough, and carbuncle, and the leaves in spermatorrhœa. In India, *P. crotalarioides, Ham.* (*Royle Ill. t.* 19. C.), a plant of the temperate Himalaya from Chamba to Sikkim, and of the Khasia mountains, has a reputation as an expectorant.

P. telephioides, *Willd.*, growing in the Western Peninsula, has a similar reputation.

P. chinensis, *Linn.*, is common in pasture lands throughout India in the rainy season. It is called Merádú in Hindi and Négh in Marathi; and is not used medicinally. A species of *Polygala* is the Furfur of the Persians and Lubánat of the Arabians.

Like Senega all these plants owe their medicinal properties to the presence of a substance closely related to, if not identical with, saponin.

CARYOPHYLLEÆ.

SAPONARIA VACCARIA, *Linn.*

Fig.—*Mor. Ox.* 5, 21, 27. *Syn.*—Gypsophila Vaccaria. Perfoliate Soapwort (*Eng.*).

Hab.—Wheat fields throughout India and Central Europe. The root.

Vernacular.—Sábúni (*Hind., Beng.*).

History, Uses, &c.—The root of a plant named στρούθιον was used by the Greeks for washing wool on account of its saponaceous qualities. (*Theoph. H. P.* vi. 4, 3; *Dios. II.*, 152.) This root was also used medicinally. (*Hipp. pag. Fœs.* 571, 54; *Dios., II.*, 152.)

The Romans used the same root under the names of Struthium and Radicula. Pliny (19, 18 and 24, 58) tells us that it is diuretic, laxative, and sternutatory, and was prescribed

in jaundice, cough, liver, spleen, asthma, and pleurisy; that on account of its supposed detergent action on the uterus, it was called "aureum poculum" and was also applied externally with meal to resolve tumours, &c. Struthium has been identified by some with *S. officinalis, Linn.*, and by others with *Gypsophila Struthium, Linn.*, both of them plants having properties identical with *S. Vaccaria*, which is also a European plant. The Arabs are acquainted with the soapworts under the name of El-sábuniyeh.

Boerhave and the physicians of his time employed *S. officinalis* on account of its supposed resolvent and alterative action in syphilis, Barthez in gout, and Biett for chronic skin diseases. Lebœuf, of Bayonne, was the first to discover the emulsifying properties of saponin and of tinctures of those drugs which contain it, such as Senega, Quillaya, &c.

The physiological action of saponin is that of a powerful sternutatory; injected subcutaneously it greatly irritates the tissues; Pélikan has shown that it exerts upon the motor and sensatory nerves a benumbing action approaching to paralysis. Köhler has observed that it paralyses the motor centres of the nerves of respiration and circulation. According to Schroff it augments the bronchial secretions and acts as a diuretic and purgative. The supposed emmenagogue action of the soapworts has not been proved. As a medicine, saponin has not as yet been tried, but drugs which doubtless owe their activity to its presence have been long in use in India and elsewhere.

Description.—*S. Vaccaria* is a tall, robust, simple or sparingly branched, perfectly glabrous annual, with oblong-acute leaves, and linear-oblong cauline leaves. The flowers are in dichotomous cymes, and of a pink colour. The taste of the entire plant is bitter and saline. The roots are very long and cylindrical, branching, and about the size of a quill, bark externally reddish, thick, and easily separable; internally firm and white.

Chemical composition.—An infusion of the root is blackened by salts of iron, and its decoction froths like soap and water.

The powdered root exhausted with boiling alcohol yields saponin, which is deposited on the cooling of the alcohol. Saponin is a white, amorphous, friable, inodorous substance, having an acrid taste. It is very soluble in water, and forms with it an emulsion. It is insoluble in ether, soluble in weak spirit and in boiling absolute alcohol. Treated with an acid and its solution boiled, saponin is converted into sapogenin and sugar—

$$C^{32} H^{54} O^{18} + 2 H^2 O = C^{14} H^{22} O^2 + 3 C^6 H^{12} O^6.$$

Sapogenin is soluble in alcohol and ether, and crystallizes from the former by slow evaporation in concentric groups of needles. From solution in dilute aqueous potash it is precipitated by stronger potash-ley, as flocculent potassium sapogenin; the solution in alcoholic potash is precipitated by water only when the potash is in excess. When sapogenin is heated with potassium hydrate till decomposition commences, part of it is resolved into acetic acid, butyric acid, and a soft brown substance, and the undecomposed portion when separated by potash melts at 128°, whereas before the treatment with potash it does not liquefy at that temperature. The compound obtained by Fremy from saponin and designated as æsculic acid, is regarded by Rochleder as $C^{26} H^{42} O^{12}$, and its formation is represented by the equation—

$$C^{32} H^{54} O^{18} = C^{26} H^{42} O^{12} + C^6 H^{12} O^6.$$

Christophson (*Archiv. d. Pharm.* VI., 132, 481), obtained from *Gypsophila Struthium* root 14·59, 15·0, 13·31, and 13·2 per cent. of saponin; and from *Saponaria officinalis* root 4·78 and 5·09 per cent.

DIANTHUS ANATOLICUS, *Boiss.*

Hab.—Western Tibet to Armenia.

Vernacular.—Kanturiyun (*Pers., Ind.*).

History, Uses, &c.—This plant has been introduced into the Materia Medica of the East as a substitute for

Erythræa Centaurium, Pers., the Centaury of the British Flora, which it only resembles in having pink flowers. *D. anatolicus* is a densely-tufted plant, with a much-branched, short, woody stock; stems 6 to 10 inches, very slender, strict, one or more flowered; leaves rigid, slender, with a very thick midrib and margin; bracts with sometimes foliaceous points; calyx teeth subacute; petals rosy, blade small, broad, crenate-toothed. The plant contains a little saponin. It is imported from Persia *viâ* Bombay.

Polycarpæa corymbosa, *Lam., Ill.* 2798; *Wight Ic.*, t. 712. A small plant found in many parts of India from the Himalaya to Ceylon, is administered in Pudukota both externally and internally as a remedy for the bites of venomous reptiles. Its Tamil name is Nilaisedachi. It may possibly contain a little saponin, but we have not thought it of sufficient importance to be examined.

PORTULACEÆ.

PORTULACA OLERACEA, *Linn.*

Fig.—*Plant. Grass.* 123; *Rheede, Hort. Mal.* x., 36. Purslane (*Eng.*), Pourpier potager (*Fr.*).

PORTULACA QUADRIFIDA, *Linn.*

Fig.—*Jacq. Col. Il.*, t. 17, f. 4; *Rheede, Hort. Mal.* x., 31.

Hab.—All warm climates.

Vernacular.—Lonia (*Hind., Beng.*), Kurfah (*Pers.*), Bhuigholi (*Mar.*), Passoke Keeray (*Tam.*), Loni (*Guz.*).

History, Uses, &c.—The creeping annual Purslane has probably been long used as a domestic remedy by the Hindus. The Sanskrit names are Loniká and Lonámla. The fresh leaves are acid, and are prescribed when bruised as a cooling external application in erysipelas; and an infusion of them is given as a diuretic. In Arabic and Persian works the herb is

called Bāklat-el-humaka or Baklat-el-mubarika and Kurfah; two kinds are described, the large and the small. The former is probably *P. oleracea*, as its use as a vegetable is noticed. Both kinds are said to be cold and moist, and to have detergent and astringent properties. Portulaca is the ἀνδράχνη of Dioscorides (ii., 113), and is mentioned by Celsus (2, 33), who calls it Portulaca. Macer says:—

> *Andrachne Græcis quæ portulaca Latinis*
> *Dicitur, hæc vulgi* pes pulli *more vocatur.*

(*Pulli pes, i.e.*, poulpied, whence the modern name pourpier.) The plant and seeds are recommended in a great many diseases of the kidneys, bladder, and lungs, which are supposed to be caused by hot or bilious humours. They are also praised as an external application in burns, scalds, and various forms of skin disease. Ainslie mentions *P. quadrifida* and *P. oleracea* as being used in Southern India by Tamil physicians. These herbs can be obtained in most vegetable markets, and the seeds of *P. oleracea* are kept in druggists' shops. In Guadaloupe, *P. pilosa, Linn.*, is known as pourpier amer or quinine-pays, on account of its bitter and febrifuge properties. It is best administered in the form of a tincture composed of Bitter purslane 100 parts, Rum 150 parts, Bordeaux wine 850 parts, Citrate of iron 5 parts. Dose 60—100 parts.

Description.—The two Portulacas, called Barra and Chota Lonia in Hindustani, may be readily recognised by their low growth, succulent, flat or nearly cylindrical leaves, and small yellow flowers (in *P. quadrifida* there are tufts of bristles in the axils), the seeds are black, minutely tubercled, and kidney-shaped; those of *P. oleracea* are much the largest. The leaves contain acid potassium oxalate and mucilage.

TAMARISCINEÆ.

TAMARIX GALLICA, *Linn.*

Fig.—*Wight. Ill.*, t. 24 *A.*; Var. ramosissima, *Ledeb. Ic. Fl. Ross.*, *t.* 256. Tamarisk (*Eng.*), Tamarisc de France (*Fr.*).

Hab.—Asia, Europe, Africa. The galls and manna.

Vernacular.—The galls, Barrí Máin (*Hind.*), Samrat-ut-Turfah (*Arab.*), Magiya-main (*Bomb.*), Gazbar, Gazmázú (*Pers.*); the manna, Gazangabín and Gazanjabín (*Arab.*, *Pers.*, *Ind.*).

History, Uses, &c.—This small tree or bush is widely distributed in Europe, Africa, and Asia. Dioscorides, speaking of μυρίκη says that in Egypt and Syria it bears a seed like a gallnut, which is used as an astringent. (I., 101.) Pliny calls the same tree Tamarica (24, 41). It is the Tamarix of Columella (8, 15). Nicander calls the Tamarix μάντιν (prophetic). The Apollo of Lesbos is represented with a branch of the tree in his hand. The Persian Magi also prophesied with a branch in their hands. Herodotus and Pliny mention a similar use of the Tamarix. In Sanskrit it is called Jhávuka, and in Hindustáni *Jhau*. The galls have probably long been used in Northern India as a substitute for the true gall. The manna is not produced in India, but in Persia and Arabia; in the month of June it drops from the tree, and is collected. In Persian works the galls of the Tamarix are called the fruit, and the manna is described as a dew which falls upon this and other trees, notably the willow and oak, and becomes solidified. The Hakíms consider the manna to be detergent, aperient, and expectorant. It is probably the δροσομελι of Galen. In modern medicine manna is still used as a laxative; it slightly increases the action of the bowels, causing more frequent and softer stools without irritation. Its sweet taste makes it acceptable to children. The galls like those of the oak contain tannic and gallic acids, and may be used as an astringent in the same manner as true galls. (*See* Quercus.)

Description.—The galls are much smaller than true galls, 3-angled, and knotty; in the centre is a cavity which sometimes contains the fly, but generally only excrementitious matter. The manna occurs in small grains, which are nearly white when fresh, but in this climate have a tendency to liquefy and form a thick yellow fluid like honey; it is produced upon Tamarisk, willow and oak, in consequence of

the puncture of an insect. According to Ehrenberg, the insect which attacks the Tamarisk is the *Coccus manniparus.* The name Gazangabín signifies Tamarisk-honey, and is used, according to Haussknecht, at the present time in Persia to designate a manna collected in the mountain districts of Chahar-Mahal and Faraidan from two species of Astragalus (*confer. Pharmacographia*, p. 371). This account agrees with that found in Persian works on Materia Medica, which describe Gazangabín as the produce of several trees. Rich (*Residence in Koordistan*, Vol. I., p. 142,) describes the collection of Gazangabín, called by the Koords *Ghezo*, by picking the leaves of the trees, letting them dry, and then gently threshing them over a cloth. The season commences about the end of June. Aitchison states that in Khorasan it is produced by *Cotoneaster nummularia, Fisch. et Mey.**; the shrub is called Siyah-chub, and is very abundant upon the Siyah-Koh and Sufed-Koh hills and in the Ardewán Pass, forming thickets: the manna forms in July and is shaken into a cloth.

Chemical composition.—Tamarisk manna from Sinai, examined by Berthelot, was a thick yellow syrup, and was found to consist of cane sugar, inverted sugar (levulose and glucose) dextrin and water, the last constituting one-fifth of the whole. A specimen of Persian Gazangabín yielded to Ludwig dextrin, uncrystallizable sugar and organic acids. The galls contain as much tannic acid as oak-galls and are readily purchased by manufacturers when offered for sale in Europe.

Commerce.—Gazangabín is imported into Bombay from Persia. Value Re. ½ per lb.; it is kept in most druggists' shops. The galls are sometimes abundant; at others unobtainable. Value, Rs. 12 to 13 per maund of 37½ lbs.

Tamarix articulata, *Vahl. Symb. ii.*, 48, *t.* 32. The galls.

* The leaves found in the Gazangabin imported into India are certainly those of Cotoneaster, as may be seen by a comparison with Aitchison's figure. (*Trans Linn Soc*, 2nd *Ser. Botany, Vol. III., Pt. I.*, 9)

Vernacular.—Choti Main (*Hind.*); Samrat-el-Asl (*Arab.*), Magiya-main (*Bomb.*), Gazbar and Azbah (*Pers.*). The tree is abundant in Sind and the Punjab, and is often cultivated. The galls are made use of as a substitute for true galls, a description of their properties and uses will be found in Arabic and Persian works under the name of Sumrat-el-Asl; these do not appear to differ in any important particular from the uses to which common galls are applied. These galls are smaller than those of *T. gallica*, and are not 3-angled; they are round, knotty, of the size of a pea, and of a yellowish brown colour. Small Tamarisk galls are occasionally offered in the market in large quantities, but are often not obtainable. Value, Rs. 12 to 14 per maund of 37½ lbs.

HYPERICINEÆ.

A number of species of Hypericum are found in the hilly parts of India, chiefly in the North, where *H. perforatum*, *Linn.*, is recognised by the Mahometans as representing the ὑπέρικον or ἀνδρόσαιμον of the Greeks. In Persia a plant, described by Mahometan writers on Materia Medica as a species of Hyufárikún (Hypericon) is known by the local names of Dádi and Jau-i-jádú or "magic barley." To these plants are ascribed the medicinal virtues which were formerly attributed to the St. John's worts of Europe; the old name of which was Fuga Dæmonum, in allusion to their supposed power of expelling the demon of hypochondriasis. Hypericum was also thought to act as a charm against witchcraft. On account of the red juice of the flowers, which was considered a signature of human blood, it was called ἀνδρόσαιμον by the Greeks, and was used as an application to wounds. The *Hypericum Androsæmum* of the botanists is the large bushy plant, so common in shrubberies in England, it is the Toute saine of the French, the Tutsan of the English, and the Rumman-el-anhar of the Arabs. By some it is considered to be the Hypericon of the Greeks. These herbs are bitter and astringent, and were formerly supposed to have detersive, resolutive, anthelmintic, diuretic and emmenagogue

properties when given internally. Externally they were used as vulneraries, and as excitants in chronic rheumatism. They are not used in modern medicine.

Chemical composition.—When the flowers of *H. perforatum*, freed from their calices and dried, are exhausted with absolute alcohol, and the tincture is evaporated, a soft residue is left of a red colour (hypericum red) together with volatile oil. If the flowers are exhausted with water, then with dilute alcohol, well dried after exhaustion, and the colouring matter extracted from them by ether, it remains on evaporation as a blood-red resin, having an odour of chamomile. It melts below 100° and does not yield ammonia by dry distillation. It is insoluble in water and in dilute acids. By aqueous ammonia, potash and soda, it is coloured green and dissolved; the saturated solution is red by reflected light, but exhibits after dilution a green colour by transmitted light. The ammoniacal solution leaves on evaporation a neutral blood-red resin having the odour of hypericum, soluble with yellow colour in water, and giving off ammonia when treated with potash. The red combines also with the alkaline earths proper, and heavy metallic oxides; its alcoholic solution precipitates the alcoholic solution of chloride of calcium, also neutral acetate of lead and ferric chloride. It dissolves in alcohol, more readily in ether, with wine-red to blood-red colour, also in volatile oils and in warm fixed oils (*Buchner.*) According to Marquart, the colouring matter of the fresh flowers is a mixture of anthocyan and anthoxanthin, separable by exhausting with alcohol and treating the residue with water.

GUTTIFERÆ.

GARCINIA INDICA, *Chois.*

Fig.—*Bent. and Trim., t.* 32; *Wight, Ill. I.*, 125. Red Mango (*Eng.*), Garcinia à fruit acide (*Fr.*).

Hab.—Western Peninsula, Amboyna. The fruit, seeds, and bark.

Vernacular.—The fruit, Ratámbi, Bhirand (*Mar.*), Brindao (*Goa*); the oil, Kokam cha tel, Bhirandel (*Mar.*); the bark, Ratámbi sála (*Mar.*).

History, Uses, &c.—The tree is common on the Western coast between Damaun and Goa; it grows wild upon the hills of the Concan, but is often to be seen in gardens close to the sea. It flowers about Christmas, and ripens its fruit in April and May. The fruit is largely used all along the Western coast as an acid ingredient in curries, and is an article of commerce in the dry state. It is generally prepared by removing the seeds and drying the pulp in the sun: the latter is then slightly salted and is ready for the market. It is known as *Amsul* or *Kokam*, and was in use in the Bombay Army as an antiscorbutic in 1799. (*Dr. White.*)* In Goa the pulp is sometimes made into large globular or elongated masses. The seeds are pounded and boiled to extract the oil, which, on cooling, becomes gradually solid and is roughly moulded by hand into egg-shaped balls or concavo-convex cakes. This is the substance known to Europeans as *Kokam butter*. The natives occasionally use it for cooking, but it is mostly valued on account of its soothing properties when used medicinally. The juice of the fruit is sometimes used as a mordant in dyeing, and the apothecaries of Goa prepare a very fine red syrup from it, which is used in bilious affections. Nothing seems to be known of the history of the Kokam fruit before the time of Garcia d'Orta (1563), who found it in use at Goa, under the name of Brindão,† when he visited that city; the same name is still used by the native Christians. As it was an article of export in Garcia's time, there can be little doubt that it was used in Western India long before the Portuguese visited the country, just in the same manner as it is at the present day. The tree was known to Rumphius, who calls it Folium acidum majus or Groot Saur-

* MS. note signed by him in the Bombay Asiatic Society's copy of Rumphius.

† A corruption of the Marathi name भिरंड Bhirand.

blad. He says the young leaves are acid like sorrel, and are used in cooking fish in Amboyna. Kokam butter appears to have first attracted the notice of Europeans about 1830 as a remedy for excoriations and chaps of the skin; in order to apply it, a piece is partially melted and rubbed upon the affected part. It is also of great value for the preparation of Nitrate of Mercury ointment, which if made in the usual manner is too fluid for hot climates; Indian lard being very fluid, equal parts of it and Kokam oil will be found to make an ointment of good consistence and colour which keeps well. The bark is astringent, and the young leaves after having been tied up in a plantain leaf and stewed in hot ashes, are rubbed in cold milk and given as a remedy for dysentery.

Description.—The fruit is spherical, about the size of a small apple, red, containing an acid pulp of a still deeper colour, in which from 5 to 8 reniform seeds are embedded; the seeds are compressed laterally, wrinkled, about ¾ of an inch long by 4-10ths broad; the cotyledons are very thick, closely adherent, and have a sweet oily taste. Kokam butter is of a yellowish white colour, firm, dry and friable in the hottest weather, and greasy to the touch like spermaceti; its structure is crystalline; it generally contains impurities, and requires to be remelted and strained before it can be used for pharmaceutical purposes; the residue after this process consists chiefly of particles of the fruit and seed.

Microscopic structure.—The cotyledons are composed of large reticulated cells containing crystalline fat.

Chemical composition.—Flückiger and Hanbury give the following account of it:—"Purified Kokum butter, boiled with caustic soda, yields a fine hard soap, which, when decomposed with sulphuric acid, affords a crystalline cake of fatty acids weighing as much as the original fat. The acids were again combined with soda, and the soap having been decomposed, they were dissolved in alcohol of about 94 per cent. By slow cooling and evaporation, crystals were first formed, which, when perfectly dried, melted at 69·5° C.; they

are consequently Stearic acid. A less considerable amount of crystals which separated subsequently had a fusing point of 55° C., and may be referred to Myristic acid. A portion of the crude fat was heated with oxide of lead and water, and the plumbic compound dried and exhausted with ether, which after evaporation left a very small amount of liquid oil, which we refer to Oleic acid. Finally the sulphuric acid used at the outset of the experiments was saturated, and examined in the usual manner for volatile fatty acids (butyric, valerianic, &c.), but with negative results.

"The fat of the seeds of *G. indica* was extracted by ether and examined in 1857 by J. Bouis and d'Oliveira Pimentel. It was obtained to the extent of 30 per cent., was found to fuse at 40° C., and to consist chiefly of stearin (tristearin). The seeds yielded 1·72 of nitrogen. Their residue after exhaustion by ether afforded to alkaline solutions or alcohol a fine red colour." The dried fruit sold in the bazaar as kokam has been examined by Lyon (1881) with the following results:—Moisture, 37·04; hot water extractive, 42·90; cellulose, 5·52; insoluble residue, 14·54. Hot water solution bright red and very acid, turns bluish green on addition of alkalies in excess; acidity due to Malic acid. Tartaric acid either absent or traces only present. No Citric acid. Fixed free acidity = 13·537 per cent. Malic acid. Total ash 7·88. Insoluble in water 1·96; soluble in water 5·92. Chlorine of soluble ash as Na Cl = 4·62 per cent. Alkalinity of soluble ash as potash = 0·79 per cent. The Chloride of Sodium is probably introduced when the kokam is salted.

Commerce.—The dried fruit comes from Goa, Hingoli and Malwan. Value, Rs. 40 per candy of 28 Bombay maunds of 28 lbs. each.

Kokam butter comes from Goa. Value, Rs. 5 to 7 per Surat maund of 37½ lbs.

Garcinia Zanthochymus, *Hook. f., Roxb. Cor. Pl. II*, 51, *t.* 196. A tree of Eastern Bengal, Eastern Himalaya,

Eastern Peninsula, Western Peninsula, produces a yellow fruit the size of a small apple and very acid, which is used for the same purposes as that of *G. indica*; it is dried and made into a kind of Amsúl. In bilious conditions a sherbet made with about 1 oz. of the amsúl with a little rocksalt, pepper, ginger, cummin and sugar, is administered. The native name is Outh. or Osht.

GARCINIA MANGOSTANA, *Linn.*

Fig.—*Bot. Cal.* 815. Mangosteen (*Eng.*), Mangostan (*Fr.*). The rind.

Vernacular.—Mangustan (*Ind.*).

Hab.—Malayan Peninsula, Southern Tenasserim.

History, Uses, &c.—The rind, or entire fruit dried, of the well-known mangosteen is brought to India from the Straits and Singapore, and is a popular remedy for diarrhœa and dysentery. Rumphius tells us that the Macassars also use the bark and young leaves for the same purpose and to cure aphthæ of the mouth. Dr. S. Arjun, of Bombay, has found the rind very useful in the chronic diarrhœa of children. It has also been used as a febrifuge. The medicinal action of this drug appears to be chiefly due to the tannin which it contains (*see* Quercus). The physiological effects of the crystallizable substance mangostin and of the resin have not been studied, but the drug may probably be classed with the terebinthinate astringents.

Description.—The fruit is globular, as large as a small apple, with a thick woody rind: it is crowned by the calycine segments, which form a kind of rosette: within it is a sweet acidulous white pulp and several seeds. The thick rind and the bark of the tree are very astringent, and yield an astringent extract which may be given in pills or syrup.

Chemical composition.—W. Schmidt has obtained a crystallizable substance, *Mangostin*, $C^{20} H^{22} O^5$, from the rind of the

fruit. To obtain it the rind is first boiled in water to remove tannin, and afterwards exhausted by boiling alcohol; upon evaporation of the alcoholic extract, a yellow amorphous mass is obtained, which consists of mangostin and resin; this is redissolved in boiling alcohol, and water added to the boiling solution as long as it causes a precipitate of resin. From the solution on cooling mangostin is obtained in small yellow scales; it may be purified by resolution in alcohol and precipitation by subacetate of lead; remaining traces of resin are removed by the addition of water to the alcoholic solution, and finally, after several recrystallizations from weak alcohol, the mangostin is obtained in thin golden yellow scales, which are tasteless, and fuse at about 190° C.; at a higher temperature it is decomposed, a portion subliming unchanged. Mangostin is insoluble in water, but readily soluble in alcohol and ether; its solutions are neutral, hot dilute acids dissolve it without change, hot concentrated nitric acid converts it into oxalic acid, sulphuric acid forms with it a deep red solution and chars it if heated. It forms yellow solutions with alkalies. It reduces solutions of the noble metals, and turns perchloride of iron of a dark green colour, which is removed by the addition of an acid. (*Ann. der Chem. und Pharm.*, t. xciii., p 83; *Wurtz, Dict. de Chim.*, t. ii., p. 310.)

GARCINIA MORELLA, *Desrouss.*

Fig.—*Bentl. and Trim.*, *t.* 33; *Wight Ic.*, *t.* 102. Gamboge tree (*Eng.*), Guttier des peintres (*Fr.*).

Hab.—Eastern Bengal, Western Peninsula, Eastern Peninsula, Ceylon. The gum-resin.

Vernacular.—The tree, Makki-maram, Korakapuli (*Tam.*) Jarigehulimara (*Can.*), Tamál (*Hind.*, *Beng.*, *Mar.*). The juice Tamál (*Hind.*, *Beng.*, *Mar.*, *Can.*) The drug Gamboge, Usāreh-i-Rewand, Gotaganba (*Pers.*, *Ind.*), Revanchi-no-sirc (*Guz.*).

History, Uses, &c.—The Gamboge tree of Malabar and Canara, which is also found in other parts of India, is by Beddome called *G. pictoria* and kept distinct from *G. Morella*. Hooker considers them both to be the same species. There would seem to be no doubt that Gamboge has never been collected in India as an article of commerce; and that it is only from a comparatively recent date that the drug has been known in this country; but the Hindus of Canara and Mysore, and probably of other parts of India, have for a long time used the juice of this tree under the Sanskrit name of Tamála as a pigment for making sectarial marks on the forehead, and this name is still current in Hindi, Bengali and Marathi. Other Sanskrit names for the tree are Tápeecha and Tápinja. The Ussárah-i-Rewand of Arabic and Persian books is, properly speaking, an extract of Rhubarb, as the name implies, but owing to a similarity in properties and also in colour, the same name was applied to Gamboge upon its becoming known as an article of commerce. Siam Gamboge is the only kind obtained in the drug markets. An interesting account of the history of commercial Gamboge will be found in the *Pharmacographia* from which it appears that it only became known to the Chinese about A.D. 1300, and was not introduced into Europe before 1603. Reudenius (1614—1625) described its medicinal properties and recommended its use as a purgative in arthritis (gout).

Description.—Through the kindness of Dr. Davies, when Civil Surgeon in Canara, we received a specimen of Gamboge collected there. It is in irregular fragments, and appears to have been collected upon leaves, portions of which still adhere to it. The finer pieces have the colour and consistence of Siam Gamboge, but contain many impurities, such as portions of wood and leaves. Fully half the sample is of a dirty yellowish brown colour, and has a spongy structure; this portion, treated with rectified spirit, gives a clear deep orange solution like ordinary Gamboge, but leaves a copious greenish yellow marc, which appears to be chlorophyll. As at present collected, this Gamboge is too impure for commercial purposes.

Chemical composition.—Indian Gamboge has been found by Christison (1846) to be essentially the same as that of Siam. It has also been examined by Broughton (1871), who is of opinion that it is equal to that of Siam. A sample of Gamboge from the Nagar district in Mysore was found by one of us to be remarkably pure; it had the following percentage composition:—Moisture, 5·4; resin, 80·4; gum, 13·0; dross, 1·2.

Commerce.—In the Indian markets the ordinary pipe Gamboge is alone met with. Price, Re. 1¼ per lb.

MESUA FERREA, *Linn.*

Fig.—*Rheede, Hort. Mal. iii*, 53; *Wight Ill., t.* 127; *Ic. t.* 118. Iron wood tree (*Eng.*), Mésua Naghas (*Fr.*).

Hab.—E. Bengal, E. Himalaya, E. and W. Peninsulas, Andamans. The flowers.

Vernacular.—Nagkesar (*Hind., Beng.*), Nágchampa (*Mar.*), Nageeuram (*Tam.*), Naga-sampigi (*Can.*), Chikati manu (*Tel.*), Veila (*Mal.*)

History, Uses, &c.—This beautiful tree, with its large Cistus-like white flower, called in Sanskrit Kanjalkama and Nágkesara, is a favourite of the Indian poets. In the Naishada the poet compares the petals of the flowers from which the bees were scattering the pollen of its golden anthers, to an alabaster wheel on which Kamadeva was whetting his arrows, while the sparks of fire were dispersed in every direction. It is the *Castanea rosea indica* of Rheede, so called, because the fruits are like chestnuts in size and shape. The dried blossoms are prescribed by Hindu physicians as an adjunct to medicinal oils on account of their fragrance, and are also considered to have astringent and stomachic properties. Powdered and mixed with *ghi* (liquid butter) they are recommended by most of the later Hindu writers in bleeding piles, and burning of the feet. The root bark of *Mesua ferrea* contains

much resinous juice, which exudes freely when it is wounded ; it has a reddish brown epidermis, consisting of ten or more rows of brick-shaped cells, full of condensed resin. Within the epidermis is a variable number of rows of cells of the same shape, yellow, refractive, and containing resinous juice ; the medullary rays are also yellow and refractive ; there are numerous large laticiferous vessels ; the bark is mildly astringent and feebly aromatic, but is not bitter as stated in the Pharmacopœia of India. Rheede says that combined with ginger it is given as a sudorific. The oil of the seeds is used as an embrocation in rheumatism and as a healing application to sores. A poultice of the leaves made with milk and cocoanut oil is applied to the head in severe colds. (*Rheede.*) On the whole, the plant may be classed with the terebinthinate astringents.

Description.—The flowers are about 3 inches in diameter, sepals orbicular, thick, with membranous margins, inner pair largest, petals 4, spreading, cuneate-obovate, pure white ; anthers large, oblong, golden yellow. Fruit ovoid, conical-pointed, size of a large chestnut ; base surrounded by the persistent sepals, 1 to 4 seeded ; seeds dark-brown, testa smooth ; round the base of the young fruits a tenacious resin exudes, which in time covers them. The resin at first is soft, but hardens on exposure to the air ; it is pleasantly aromatic.

Chemical composition.—The chief principle of *Mesua ferrea* appears to be an oleo-resin which abounds in all parts of the tree, and is obtained pure from the young fruits. The fresh tears sink in water, melt between 50° and 60° C., and partially dissolve in rectified spirit, amylic alcohol and ether, but wholly in benzol. Boiled with solutions of soda or ammonia the resin forms a clear mixture precipitable by acids in a white curdy condition. The solution in spirit has an acid reaction, and is dextro-rotatory when examined by polarised light ; the solution gives a precipitate with alcoholic plumbic acetate, soluble when heated. From the partial solubility there are probably two resins present. Submitted to distillation 0·6

per cent. of a fragrant essential oil was obtained; this was of a pale yellow colour, and possessed in a high degree the odour of the flowers, and resembled that of the exudation of the Chio Turpentine.

The seeds yielded to ether 31·5 per cent. of fixed oil; the kernels alone gave 72·9 per cent. The oil thus obtained had a deep yellow colour, formed orange-coloured mixtures with sulphuric and nitric acid, was partially soluble in alcohol, and had a specific gravity of 0·972 at 17° C., a temperature at which it began to set, on account of the crystallization of the more solid fats. The hard pericarp contained a considerable amount of tannin.

Commerce—True Nágkesar is not an article of commerce in India. The oil of the seeds is sometimes offered for sale. Value, Rs. 1 per maund in Canara.

OCHROCARPUS LONGIFOLIUS, *Benth. and Hook.*

Fig.—*Wight. Ill. i.*, 130; *Ic. t.* 1999.

Hab.—Western Peninsula. The flower buds.

Vernacular.—Punnag, Támbrá-nágkesar (*Mar.*), Ráti-nágkesar (*Guz.*).

History, Uses, &c.—The dried buds of this tree are known in commerce as red Nágkesar. The tree grows in the forests of the Western Peninsula from Canara to the Concan, and is called Suringi by the Marathas and Punnága in Sanskrit; the buds are used chiefly for dyeing silk, but have also astringent and aromatic properties, and are sometimes prescribed medicinally. The fruit is eaten by children, who call it Gori-undi, or sweet Undi. The seed, which is as large as an acorn, exudes a viscid gummy fluid when cut. The medicinal properties of this plant are very similar to those of *Mesua ferrea*.

Description.—Flowers two-thirds of an inch in diameter, white, on nodes clothed with subulate bracteoles in the axils of

fallen leaves; buds globose; pedicels 1 inch, slender; calyx bursting into 2 valves, reflexed during flowering; petals 4, thin, deciduous, white; stamens many; style subulate; stigma broad, discoid. The flowers are often hermaphrodite in cultivation. The dried buds are of a reddish brown colour and of the size of a small clove.

Commerce.—Nágkesar comes principally from Rajapur. Value, Rs 2-12 to 3 per maund of 28 lbs.

CALOPHYLLUM INOPHYLLUM, *Linn.*

Fig.—*Wight. Ill. i.*, 128; *Ic. t.* 77. Sweet-scented Calophyllum, Alexandrian Laurel (*Eng.*), Calophylle faux Tacamahac (*Fr.*).

Hab.—W. Peninsula, Ceylon, E. Peninsula, Andamans. The oil and seeds.

Vernacular.—Sultán Champa (*Hind.*), Undi (*Mar.*), Punnaigam (*Tam.*), Punnágamu, Ponna-chettu (*Tel.*), Suragonnemara (*Can.*). The oil, Sarpan-ka-tel (*Hind.*), Undi-che-tel (*Mar.*), Punnai-tailam, Punnai kai, Pinna-cotai (*Tam.*), Laurel nut oil (*Eng.*).

History, Uses, &c.—This tree, wild, or in a cultivated state, is widely distributed throughout India, and is considered by some to be the Punnága or Késava of Sanskrit writers, but as its flowers are not collected, and those of Ochrocarpus are, and are still known as Punnága in Marathi, it seems probable that the latter plant is the true Punnága. The natives appear to regard both trees as varieties of one species. The Alexandrian laurel abounds in Travancore and on the Western coast. A greenish-coloured oil is expressed from the seeds, which is used for burning by the poorer classes, and is valued as an application for rheumatism, either alone or mixed with an equal portion of Hydnocarpus oil; it is also used as an application to exanthematous eruptions, and the seeds pounded with cashewnut seeds, borax and sparrow's dung are applied

as a *lep* to hasten maturation. At Pondicherry the oil has a reputation as a specific for scabies; and according to Corre and Lejanne, it has been tried unsuccessfully at the Saigon hospital as a cicatrizing agent. The Annamite name is *yao-monou*. The pounded bark is applied to swelled testicles. The tree when wounded exudes a small quantity of bright green resin, which is not collected, nor does it appear to be made use of in any way. This substance is soft and entirely soluble in rectified spirit; it has a parsley odour, and has been confounded with Tacamahaca, the exudation of *C. Calaba*, not a native of India. Rheede says that the resin is emetic and purgative; his expression is, 'the tears which distil from the tree and its fruit'; this is quite correct, as small tears of resin may often be seen adhering to the fruit.

Description.—The fruit is ovoid or round, and greenish-yellow when ripe; it varies in size; on old trees it is often as large as a bantam's egg; the pulp surrounding the nut dries up when the seed is mature, and the previously smooth skin covering it becomes brown or black and much wrinkled; the endocarp is hard, woody, and white, as thick as the shell of a filbert; within it is an inner endocarp, soft, and corky, of a red colour, thicker than the woody shell towards the apex of the fruit, but gradually becoming very thin towards the base, the inner surface of this layer is highly polished. The seed is of the same shape as the nut; it is very oily and has a rancid taste; it consists of two hemispherical cotyledons very closely united; under the microscope a stroma of small ovoid cells is seen, through which numerous large vessels loaded with green oil run in a longitudinal direction.

Chemical composition.—The resin melts easily and dissolves completely in alcohol; according to Sommer it does not yield umbelliferone by dry distillation. The oil of the almonds is greenish yellow, bitter and aromatic, sp. gr. 0·942; it solidifies at + 5°. (*Lépine.*) The fresh kernels examined by one of us gave off 30 per cent. of water in drying, and the dried kernels afforded 68 per cent. of oil. The oil was greenish-yellow, bitter,

and fragrant; sp gr. 0·9315 at 16° C.; it commenced to congeal at 19° and set at 16°. The saponification equivalent was 285·6. The oil yielded 90·85 per cent. of fatty acids, sp. gr. 0·9237 at 16° and 0·8688 at 90°, melting at 37°·6, and possessing a combining weight of 283. If the oil be shaken up with a diluted solution of soda, and the red alkaline liquor be precipitated with an acid and then shaken up with ether, the ethereal extract leaves on evaporation a green crystalline residue having the odour of melilot and a bitter taste. The odorous crystalline body is also removed by agitating the oil with 85 per cent. alcohol. The oil is non-drying. Exposed for one month to the air at a temperature of 14°—20°, and for eight hours in a water-oven kept at the boiling point, the oil did not increase in weight. Treated according to Reichardt's distillation process, the oil yielded only a minute trace of volatile fatty acids. Three drops of sulphuric acid added to twenty drops of oil gave a red coloration with orange streaks; after stirring an orange-brown mixture was produced. With nitric acid a chocolate brown mixture was formed. A residue soluble in boiling water was obtained which had the peculiar odour of coumarin, but it did not yield any crystals of that substance. The oil must be classed with the cotton seed group of fixed oils.

Commerce—The oil under the name of Laurel nut oil is exported from Southern India. The exports from Travancore for the past five years had the following values:—1882-83, Rs. 74,314; 1883-84, Rs. 68,767; 1884-85, Rs. 48,997; 1885-86, Rs. 78,845; 1886—87, Rs. 57,148. The tariff valuation of the oil is Rs. 8 per cwt. as against Rs. 14 per cwt. for cocoanut-oil. The export from Alleppy in 1886-87 was 63 cwts. In Bombay it is not exported, but the country-people express it for burning, and use it medicinally. In Ceylon it is known as Domba oil. It is chiefly exported to Burmah, where it fetches a comparatively high price.

Calophyllum Wightianum, *Wall.*, *Wight. Ill. i.*, 128; *Ic. t.* 106. Sira Punnai (*Tam. and Mal.*). This tree is abundant in Canara, where it is called Babbe, and extends to

Travancore. The gum occurs in large translucent irregular lumps of a yellowish colour; it is of horny texture, somewhat brittle, without odour; the taste is soapy. When placed in water it gradually softens, and finally disintegrates into a fine granular matter which floats in the form of flaky particles of a dirty white colour, and numerous oil globules which gradually collect upon the surface; the water dissolves a small portion and becomes slightly viscid.

Calophyllum tomentosum, *Wight, Beddome Fl. Syl. xxii., t.* 2; *Wight. Ic., t.* 110. Poon (*Eng.*). A tree of the Western Peninsula and Ceylon, in Marathi Punai, yields a gum which is black and opaque, and much mixed with pieces of corky bark; it has a feeble astringent taste, and is very soluble in cold water, to which it yields a yellow brown solution exhibiting a strong blue fluorescence. Alum followed by carbonate of soda throws down apparently some of the brown colouring matter without interfering with the fluorescence, as after precipitation the solution although lighter in colour is very strongly fluorescent.

A solution purified by alum in this way has its fluorescence immediately destroyed by acids and restored again by alkalies. Examining its absorption spectrum it is found that while fluorescent the solution gives a broad absorption band at the violet end of the spectrum extending to about G.; this band disappears on destroying the fluorescence by acids, but reappears on the addition of alkalies. The solution of the gum does not appear to rotate polarized light. The gum itself communicates only a very faint fluorescence to rectified spirit. (*Lyon.*)

TERNSTRŒMIACEÆ.

CAMELLIA THEIFERA, *Griff.*

Fig.—*Trans. Linn. Soc.* XXII., t. 61; *Bentl. and Trim.* 34. Tea plant (*Eng.*), Théier (*Fr.*).

Hab.—Upper Assam, Cachar, China. Cultivated elsewhere.

Vernacular.—Cha, Chai. (*Ind.*)

History, Uses, &c.—There is reason to believe that the use of tea was unknown before the Christian era. This has been accounted for by the fact that the districts where the plant grows wild were not till then annexed to the Chinese Empire. Its origin, like that of many other useful plants, has formed the subject of an interesting myth, which attributes its discovery to the Buddhists in the latter half of the fifth century. According to a Japanese legend related by Kaempfer, the patriarch Bodhdharma, who died in China in the year 495 A.D., was so devoted an ascetic that he denied himself even natural rest. Being one day, however, overcome by sleep, he felt, on awaking, such keen remorse for yielding thus weakly to his lower nature, that he cut off both his eyelids and flung them on the ground. From these sprang the tea-plant. The holy man partook of its leaves, and found to his surprise that it endowed him with fresh vigour to renew his meditations. He communicated his discovery to his disciples, and taught them that method of using the leaves which thenceforward became generally practised. The first mention of tea in Chinese annals is in connection with a tax imposed on it in 793 A.D. The next reference to it occurs in the account of the travels of two Mahomedans in the ninth century. Europeans, however, do not appear to have acquired any knowledge of tea until the latter half of the sixteenth century, when it is noticed by Ramusio, Maffei, van Linschoten, and Botero. Later on, it was again described by the Jesuit Trigault and by Olearius. It is generally supposed that it was first brought to Europe by the Dutch East India Company during the first half of the seventeenth century. The leaf reached Paris in 1635, and the shrub was planted there in the Royal Gardens in 1658. Russia first obtained tea in 1638, through Starkow, the envoy to the Mongol Altyn Khan, who entrusted him with two hundred packets of that commodity as a tribute for the Czar. Starkow is said to have considered it as worthless, and to have taken

charge of it very unwillingly. It found, however, great favour with the Court at Moscow, and soon became a national beverage. As regards the introduction of tea into England, the following are the most important facts to be considered. The first English vessels which ever sailed to the East and back belonged to the expedition under Lancaster, despatched by the London Company in 1601, soon after the grant of its original charter. None of these vessels returned home until after Elizabeth's death. If tea, therefore, reached England during her reign, it must have come from the East through a foreign channel. It has been supposed by some that tea was first brought over to England from Holland by Lords Arlington and Ossory in 1666. A treatise, however, by one Thomas Garnay, a retailer of tea, who wrote during the Commonwealth, proves that it was already in use amongst the English some years previously. He states that "in England it hath been sold in the leaf for six pounds, and sometimes for ten pounds the pound weight; and in respect of its former scarceness and dearness, it hath been only used as a regalia in high treatments and entertainments, and presents made thereof to princes and grandees till the year 1657." Later on in 1660, an Act of Parliament was passed, imposing a duty of eight pence on every gallon of tea made for sale. In the same year, also, Waller, the courtier-poet, wrote the following lines on the occasion of the marriage of Charles II. with Catherine of Braganza.

> "The best of queens and best of herbs we owe
> To that bold nation who the way did show
> To the far region where the sun doth rise,
> Whose rich productions we so justly prize."

From these facts we may conclude that tea was first introduced into England through the Portuguese before the year 1657. It is, however, highly improbable that it was long before that date, for until then it appears only as a very scarce and expensive luxury, and is not mentioned by a single earlier English writer. (*Tyrrell Leith.*)

There are two well-marked kinds of tea distinguished as black and green, of each of which we have several commercial varieties. Thus, of black teas, the best known sorts are Congou, Souchong, Oolong, Pekoe and Caper; and of green teas—Hyson, Hyson-skin, Young Hyson, Twankey, Imperial and Gunpowder. Many teas are scented with the flowers of the orange, rose, jasmine, sweet-scented olive, &c. The finest teas, some of which sell for as much as 50s. per lb., are consumed by the wealthier classes in China and Russia, and to a small extent in India. These teas are not manufactured in India. The various kinds of tea are all prepared from the same plant: thus, green tea consists of the leaves quickly dried after gathering, so that their colour and other characters are in a great measure preserved, and black tea consists of the leaves dried some time after being gathered, and after they have undergone a kind of fermentation, by which their original green colour is changed to black, and other important changes produced. It should be noticed, however, that much of the green tea is coloured artificially with a mixture of Prussian blue and gypsum, or indigo and gypsum, to which a little turmeric is sometimes added.

Both black and green teas are frequently adulterated with the leaves of other plants. The colour, odour and taste of both green and black teas are communicated to hot water, an infusion of the former having a more or less greenish-yellow colour, a peculiar aromatic odour, and an astringent feebly pungent and agreeably bitter taste; while an infusion of the latter has a dark brown colour, a somewhat similar but generally less agreeable odour, and an astringent, bitterish, but less pungent taste. The principal use of tea is to form an agreeable, slightly stimulating, soothing, and refreshing beverage. It was also formerly believed that tea, from the *theina* it contained, had the effect of diminishing the waste of the body, and as any substance that does this necessarily saves food, it was regarded as indirectly nutritive; but Dr Edward Smith has shown that, on the contrary, tea increases the bodily waste by acting as a respiratory excitant, and in other

ways. From containing gluten, tea has also been regarded as directly nutritive, but in the ordinary mode of making tea this substance is not extracted to any amount. The action of tea is thus described by Dr. Smith :—"It increases the assimilation of food both of the flesh and heat-forming kind; and with abundance of food must promote nutrition, whilst in the absence of sufficient food it increases the waste of the body." Tea is also a powerful astringent, and should not, therefore, be taken until some time after meals, as it is likely to produce dyspepsia from the combination of its tannic acid with the gelatine of the food and the production of an insoluble tannate; for the same reason if taken in excess it is likely to cause constipation. Tea should not be taken as a beverage by those who suffer from wakefulness, or by those who are liable to hysteria, or palpitation of the heart from valvular disease. As a nervine stimulant tea may be taken with advantage for headache and neuralgia, and in other affections caused by exhaustion of the system from depression of nerve power. Its effects as a nervine stimulant are due to the *theine* contained in it. (*Bentl. and Trim.*)

Pratt's experiments with *theine* seem to show that the motor nerves are not affected by it; he surrounded one crural nerve of a frog with a paste of theine and water, and irritated the spinal cord, when both legs responded with uniform alacrity. Pratt also found that when the left sciatic nerve of a beheaded frog was surrounded by a paste of theine and water, after ten minutes, irritation of the right foot produced reflex movements, whilst irritation of the left foot failed to elicit any response.. T. J. Mays (*Polyclinic. Sept.*, 1887,) has shown that in theine we possess an agent which exerts no injurious action upon the organism, even when administered in large doses. To obtain this effect of theine he found subcutaneous injection sufficient, and in local neuralgias he injected as much as 15 centigrammes with excellent results. These injections were repeated daily for 21 days in obstinate cases with the effect of entirely subduing the pain; they caused no local irritation, nor did they interfere in any way with the patient's appetite or

prevent him sleeping. For subcutaneous injection theine should be combined with an equal portion of benzoate of sodium, which greatly increases its solubility. Pratt and others have shown that muscular fibre when brought in contact with theine, becomes strongly contracted, but it is uncertain whether this effect is produced by coagulation of the myosin or not. In muscles which had been soaked in curare until the nerves were killed the same rigidity was produced.

In comparing the physiological effects of theine and caffeine upon the excretions, it has been found by some experimenters that the former does not affect the elimination of carbonic acid, while the latter diminishes it, as well as the discharge of urea, uric acid, and water, in a larger proportion than theine. Caffeine also is said to increase the watery constituent of the urine, whilst theine diminishes it. However this may be, it is a matter of familiar observation that the effects of tea and coffee upon the system are by no means identical; for while coffee causes wakefulness as well as tea, in the former case it is rather a pleasing insomnia, not unlike that occasioned by small doses of opium, tranquil for the most part, and filled with pleasing reveries: while tea, on the other hand, induces in one who in vain endeavours to sleep after its use, a state of tension of the nervous system which is in the highest degree distressing. Upon almost every one coffee acts as a stimulant which is more or less cordial, flushing the face and rendering the pulse fuller, but such effects never follow the use of tea as direct consequences. It is seldom that a single indulgence in strong coffee induces that nervous agitation and tremulousness and impaired muscular power which are ordinary effects of strong tea; and unless we are greatly mistaken, gastralgia and other neuralgic affections are much more frequent among tea-drinkers than coffee-drinkers. It is very true that some of these apparent differences may be explained by the fact that tea is generally taken with only a small modicum of cream or milk, while coffee is as commonly used with a large proportion of one or both. Indeed, in France, where coffee is the universal breakfast drink, it is

always mixed with a great excess of milk, and is used pure chiefly after dinner, when the presence of food in the stomach retards its absorption and modifies its action. It is however customary for those who have mental or bodily work to perform before breakfast, to take a cup of "black coffee" immediately on leaving bed.

Theine and caffeine do not fully represent the sources from which they are respectively obtained. The identity of these alkaloids in their physiological action does not imply a similar identity in tea and coffee. As little should we be entitled to infer that all alcoholic drinks produce identical effects because they all contain alcohol as their chief constituent. It is just as certain that tea and coffee differ in their action upon the human system as that Rhenish or Bordeaux wine acts very differently from whisky or brandy, although in all of these liquors the common cause of their effects is alcohol. Moreover, not only are theine and caffeine physiologically identical, but so are guaranine, cocaine, and theobromine with them and with one another; and yet the operations of guarana, coca, and theobroma are different from one another, and from those of tea and coffee, in important particulars. It is unquestionably a fact of the highest possible interest that all of these vegetable products, which are used by different and remote nations, should contain identical proximate principles; but while we thus are led to admire the universality of physiological laws, we should not lose sight of the peculiarities which distinguish these important articles of human food from one another. (*Stillé and Maisch.*)

Chemical composition.—From some experiments made by us with fresh tea leaves, which had been dried by exposure to air, and which had not been subjected to any manufacturing operations, it would appear that gallic acid exists in the fresh leaf in only minute traces; but as the leaf during manufacture of tea is exposed to a high temperature, it is possible that the gallic acid in commercial tea may be present to a larger extent. Regarding quercetin, no distinctive needle-

shaped crystals could be obtained, though a principle similar to it is present.

In the last edition of Bloxam's Chemistry it is stated the aroma of tea does not belong to the fresh leaf, but is produced, like that of coffee, during the process of drying by heat, which develops a small quantity of a peculiar volatile oil having powerful stimulating properties. The freshly dried leaf is comparatively so rich in this oil, that it is not deemed advisable to use it until it has been kept for some time. We have found that freshly gathered leaf which has been dried simply by exposure to air possesses in a marked degree the aroma of manufactured tea. Our experiments would lead us to infer that the bouquet of tea is not solely dependent upon this volatile oil, which exists ready formed in the leaf, but is also due to the development by the action of heat, or some principle present in the leaf, of another odorous principle, and that the temperature necessary for the production of this secondary odorous principle need not exceed 100° Fahr.

Regarding the use of freshly manufactured tea, there appears to be an idea among some tea-planters that the use of the freshly manufactured article causes dysentery, but we are not in possession of the data on which the statement is founded.

A sample of tea bark contained 1·2 per cent. of theine, a much lower amount than is usually found in the leaves.

Manufactured tea contains a *volatile oil*, *gallotannic* and *gallic acids*, *quercetin*, and the so-called *boheic acid*, also the alkaloid *theine* said to be identical with caffeine obtained from coffee, and with the alkaloids of cocoa seeds, guarana, Paraguay-tea, and kola nuts; more recently zanthine and another alkaloid, theophylline (dimethylzanthine) have been discovered in it. Theine and caffeine are trimethylzanthine. Zanthine is found in muscles, and along with creatine, assists muscular power, they are products of muscular waste. The occurrence of xanthine in tea was shown by Baginsoky in 1884 (*Zeits. f. Phys. Chem.* viii., 395.) and Kossel 1888 (*Ber. der. deutschen Chem. Ges.*

No. 11, p. 2164,) described a new base which he named *theophylline*, very similar in character to theobromine. It melts at 264° C., and sublimes at a temperature above its melting point. The crystals are larger than those of theobromine, but have the same chemical composition. Theophylline forms definitely crystallizable salts with hydrochloric and nitric acids, platinum chloride and gold chloride, as well as a crystallizable sparingly soluble double salt with mercuric chloride. Its formula is $C^7 H^8 N^4 O^2$.

Battershall (*Food Adulterations*) gives the following as the results of the analysis by American chemists of samples representing 2,414 packages of Indian teas :—

	Per cent				Average per cent.
Moisture	5·83	to	6·325	—	5·938
Extract	37·80	,,	40·35	—	38·841
Total ash.....................	5·05	,,	6·024	—	5·613
Ash soluble in water ...	3·122	,,	4·280	—	3·516
Ash insoluble in water.	1·89	,,	2·255	—	2·092
Ash insoluble in acid .	·120	,,	·296	—	·177
Insoluble leaf...........	47·12	,,	55·87	—	51·91
Tannin	13·04	,,	18·868	—	15·323
Theine.....................	1·88	,,	3·240	—	2·736

Dr. B. H. Paul and A. J. Cownley (*Pharm: Journ., Nov. 19th*, 1887,) give the following interesting account of an inquiry undertaken for the purpose of ascertaining the circumstances that determine the differences of "strength" in tea:—

"One of the points to which we directed our attention was the extraction of the theine in such a way that precise analytical results could be obtained admitting of a comparison of different kinds of tea in regard to the percentage of theine. After several trials we found that the method we had previously adopted for coffee was capable of furnishing satisfactory results, and that with careful manipulation the amount of theine in tea could thus be determined with considerable accuracy.

For this purpose 5 grains of powdered tea is moistened with hot water, well mixed with one grain of hydrate of lime, and the whole dried on a water bath. The dry residue is then transferred to a small percolating apparatus and extracted with strong alcohol. The clear liquor is to be evaporated to remove alcohol, and the remaining water solution, measuring about 50 c.c., mixed with a few drops of dilute sulphuric acid, which separates a trace of lime and partially decolorizes the liquid. After filtering the slightly acid solution, it is transferred to a separator and well shaken with chloroform, which gradually abstracts the theine. This part of the operation requires particular care, for though theine is freely soluble in chloroform it is necessary to shake the acidified water solution with several successive quantities of chloroform in order to remove the whole of the theine. Unless the quantity of theine is very large, about 200 c. c. of chloroform will be sufficient for 5 grams of tea, and that should be used in 5 or 6 separate portions, testing the last portions by distilling off the chloroform in a weighed flask until it is found that there is no more theine taken up. The whole of the chloroform solution is then to be placed in a stoppered separator and shaken with a very dilute solution of caustic soda. This will remove a small quantity of colouring matter and render the theine solution quite colourless, so that on distilling off the chloroform from a weighed flask the theine remains in a condition fit for weighing. When the operation is carefully carried out, the theine will be perfectly white In this way we have been able to obtain results of great uniformity.

Our first experiments were made with Indian and Cingalese tea, the general result showing that both kinds contained a much higher percentage of theine than has hitherto been generally supposed, and that the variation in the amount of this substance was not considerable. In this respect, however, there seems to be a marked difference between tea and coffee; the amount of theine in tea is by no means a constant quantity, and, so far as the tea of India and Ceylon is concerned, it varies from 3·22 to 4·66 per cent. This is taking the tea in

the ordinary air-dry condition in which it is met with in commerce. The following table gives the results of our determinations in twenty-eight samples that were selected for this purpose as representing a wide range of quality, as may be understood from the fact that the prices realised by the corresponding parcels in public sale varied from 7*d.* to 3*s.* per pound. The sample No. 10 was tea of exceptionally fine quality, that was valued at 6*s.* or 7*s.* per pound, and the sample No. 4 consisted of the hairs detached from the leaves in sifting:—

	Approximate elevation of place of growth.	Moisture per cent.	Theine per cent.	
			Original Tea.	Dry Tea.
Ceylon Tea.	Ft.			
1 Penhros	2,500	6·8	4·56	4·89
2 F. L. C.	...	6·0	4·56	4·85
3 Nahalma	300	5·6	4·51	4·80
4 Hairs from tea leaves... ..	.. ..	6 6	2·40	2·57
5 Hardenhuish Pekoe ..	3,500	3·8	4·08	4·24
6 Woodstock Pekoe Souchong	4 200	3 6	3·41	3·57
7 Radella Broken Pekoe	4,800	4·6	4·10	4 30
8 Morton Pekoe	400	4·2	3·98	4 15
9 Penhros Broken Pekoe	2,500	6·4	4 64	4·96
10 Strathellie Orange Pekoe	2,000	5 4	4·10	4·33
11 Nahalma Orange Pekoe .	300	5·4	4 06	4 29
12 Venture Orange Pekoe .	4,300	5·1	3·74	3 95
13* St. Leys Pekoe Dust	4,600	5 6	3 46	3·66
14 Venture Pekoe Souchong	4,300	4·8	3 40	3·57
15 Venture Broken Orange Pekoe	4,300	6·6	3·98	4 26
16 Calsay Pekoe Souchong .	5,000	6·2	3·22	3·43
17 Venture Pekoe	4,300	5·6	3·48	3·68
18 St. Clair Orange Pekoe ..	4,200	4·6	3·90	4·09
Indian Tea.				
19 Pekoe tips, picked out ...	... ..	7·56	4 27	4·62
20 Broken Pekoe	......	7 00	4·48	4·81
21 Pekoe	... ..	6·40	4·16	4·44
22 Orange Pekoe	......	4·80	4·66	4·89
23 Pekoe...	......	5·60	4·48	4·74
24 Broken Pekoe	.. ...	4·80	3 76	3·95
25 Pekoe	......	5·40	3·66	3·86
26 "Weak" tea	......	6·80	4 06	4·35
27 "Strong" tea.............	......	5·80	4·18	4 43
28 Mixture..........................	......	6·00	3 64	3·87

At present we have not had an opportunity of examining many samples of Chinese or Java tea that could be accepted as authentic, but so far as we have been able to judge the amount of theine is less than in the tea of India and Ceylon. But, so far as the tea of India and Ceylon is concerned, it is at least evident from the data above given, as compared with the prices mentioned, that the marketable value of tea is not to any great extent dependent on, or proportionate to, the amount of theine it may contain, however important that constituent may be in other respects. Neither can the "strength" of tea, as that term is generally understood, be taken as proportionate to the amount of theine. This is evident from the results of the analysis of the two samples, 26 and 27, which were selected by experienced judges of tea to represent extreme cases of difference as to strength. The amount of theine in 27 is greater than in 26, but to such a small extent that the difference in strength of the tea represented by those samples could not be ascribed to the theine they contain.

It appears to be much more probable that the "strength" of tea is chiefly determined by the amount or condition of the astringent constituent, the precise nature of which is at present only partially known. Moreover, when the mode of preparing tea is considered, it is also probable that this quality of "strength" may be largely influenced in degree by the manipulation of the leaves in the process of manufacture which comprises stages of fermentation and heating in the moist state in contact with atmospheric oxygen, both of which are conditions likely to induce alteration of material analogous to ordinary tannin. But before any definite opinion on this point can be offered in place of the general probability above suggested, it will be necessary to acquire a better knowledge of the chemical nature of that constituent of tea leaves which in some respects resembles ordinary tannin.

The commercial value of tea is at present estimated by a combined consideration of several factors, among which appear-

ance counts to a considerable degree. In this respect the size of the leaves, indicating their age and likewise the presence of what is termed "tip," consisting of the unexpanded leaf buds, serve as indications by which tea is classed partly as Souchong or Pekoe and partly also as varieties of those kinds of tea. In addition there is also the process of tasting practised by tea brokers. This consists in preparing infusions of the different samples much in the same manner that tea is commonly used, and then forming a judgment as to the value of the samples according to the aroma, flavour, and other characteristics of the corresponding infusions. This is an art that is practised with a surprising degree of precision, so that the results arrived at by different operators agree in a very remarkable manner. In carrying out the broker's test, tea is infused for five minutes in boiling water in the proportion of about 48 grains to $3\frac{1}{2}$ fluid ounces of water. The infusion is then poured off from the leaves into a cup, and the value of the tea estimated by its taste. In this operation the soluble constituents of the leaves are only partially extracted, and while more perfect exhaustion of the leaves will give about 35 per cent. of extract, the amount taken out in the ordinary broker's method of testing does not amount to more than 20 per cent on the average. Hence it is evident that attempts to value tea on the basis of the total amount of extract obtainable by treatment with boiling water must be entirely fallacious and useless for any practical purpose. In respect to the amounts of extract thus obtainable from tea of different qualities, there is not in reality any such difference as would afford indications of the actual differences in value. Peligot and others have made determinations of this kind, showing that different kinds of black tea yield from 24 to 47 per cent. of extract, or on the average, 34 to 40 per cent., but these data have little practical value. It is indeed not by the perfect extraction of tea that its value can be estimated. This must be sought for within the limits of extraction which obtain in the ordinary methods of using tea, as is the case in the broker's method of testing, which fairly represents ordinary

practice in the use of tea, though the infusion is then made stronger than it is generally drunk.

To obtain some idea of the extent to which the constituents of tea are extracted under these ordinary conditions we have made analyses of the infusion thus prepared, and have ascertained as a general result that the 20 per cent. of extract taken out by the infusion will contain about one-half of the theine present in the tea used. An ordinary breakfast cup of equally strong tea infusion measuring about eight ounces would therefore contain two grains of theine or thereabouts. The rest of the theine is left in the spent leaves, and it requires repeated treatment with boiling water to extract the whole quantity. This is no doubt one of the reasons why the amount of theine in tea has been under-estimated in so many instances, since experimenters have operated upon a water extract for its determination. In one instance we found that the residual leaves of tea which had been used in the customary manner contained as much as 1·7 per cent. of theine, and in another case leaves exhausted as far as practicable by percolating with boiling water still contained as much as 0·13 per cent. calculated on the original tea."

Commerce.—The great tea-producing country is China, where it is said four millions of acres of ground are devoted to its cultivation, and the produce annually is estimated at nearly three thousand millions of pounds. Tea is also largely produced in Japan, Java, Assam and Ceylon. (*Bentl. and Trim.*) Indian tea, which includes that of Assam, has now become an important article of commerce, but is objected to by many of the natives of India on account of its being more astringent than China tea; it is chiefly exported to Europe through Calcutta. The exports during the last three years have been:—In 1885-6, 68·8 millions of pounds; in 1886-7, 78·7 millions; in 1887-8, 87·5 millions, valued at 517 lakhs of rupees.

The following figures show the percentage proportion of tea imported into Great Britain in 1886 and in 1887 from different

countries, and bear witness to the increasing favour with which Indian tea is regarded in England:—

	China.	British India.	Ceylon.	Java.	Other Countries.
1876; per cent.	84·03	14·99	0 05	0·78	0·15
1877, " "	53 17	31·15	5 89	0·32	2·47

—*Chemist and Druggist, April* 1889.

Gordonia obtusa, *Wall.; Wight Ill. i.* 99, is a tall tree of the Western Peninsula from the Concan to Pulney hills, and is called Nagetta by the hill people. The leaves have been used in the Nilgiris as a substitute for tea; they resemble the tea leaf in size and shape, but may be distinguished by their obtuse points. The leaves contain a crystallizable and sublimable alkaloid like caffeine to the extent of 0·04 per cent., also tannic acid, and an odorous body very much like that contained in ordinary tea. The ash is lower: 3·96 to 3·67 per cent.

SCHIMA WALLICHII, *Chois.*

Fig.—*Griff. Notul.* iv., 562, t. 600.

Hab.—Eastern Himalaya, Nipal to Bhotan, Assam, Burma.

Vernacular—Chilauni, Makriya-chilauni (*Hind.*). The Hindi names for this tree signify "that which causes itch," "that which causes monkey's itch." The part of the tree which has this effect is the bark, in which the liber-cells appear like glistening white needles which irritate the skin like cowhage, which drug it resembles in being a mechanical irritant. The bark is thick, externally smooth, of a greyish-brown colour and very irregular surface, caused by deep fissures and exfoliation of portions of the suber; internally it is of a reddish-brown colour and short fracture, and is remarkable for a number of white glistening liber-cells about $\frac{1}{8}$ of an inch long, which when magnified are seen to be translucent and sharp-pointed at both ends. The bulk of the parenchyma consists of cells containing much starch and a red colouring matter.

DIPTEROCARPEÆ.

DIPTEROCARPUS TURBINATUS, *Gærtn. f.*

Fig.—*Roxb. Cor. Pl.* iii., 10, *t.* 213.

Hab.—Eastern Bengal, Eastern Peninsula.

DIPTEROCARPUS INCANUS, *Roxb.*

Hab.—Chittagong, Pegu.

DIPTEROCARPUS ALATUS, *Roxb.*

Fig.—*Gærtn. f. Fruct.*, iii. 50, *t.* 187.

Hab.—Chittagong, Burma, Tenasserim, Andamans. Oil Tree. The oleo-resin, Garjan Balsam, Wood oil (*Eng.*).

Vernacular.—Garjan-ka-tel (*Hind.*, *Bomb.*, *&c.*), Yennai (*Tam.*).

History, Uses, &c.—Seventeen species of Dipterocarpus are noticed in Hooker's *Flora of British India* as growing in India and the Eastern Islands, but the three placed at the head of this article produce most of the Garjan-Balsam of commerce. The Balsam does not appear to have been made much use of as a medicine by Hindus or Mahometans, for we have not found it noticed at any length in their standard works on Materia Medica. Under the name of Duhn-el-Garjan, a short notice of it will be found in the Makhzan. Ainslie mentions its use by the natives of Southern India in gonorrhœa. It was first brought prominently to the notice of Europeans by O'Shaughnessy in the Bengal Dispensatory as a substitute for Copaiba, but has never displaced that drug even in India, although favourable reports of its properties have from time to time appeared in the Medical journals. The natives of the East use it largely as a varnish, and for paying the seams of boats, as it is thought to preserve timber from the ravages of insects. Quite recently it has been brought prominently to

notice by Dr. Dougall, of the Andamans, as a remedy for leprosy. According to that gentleman, Garjan Balsam when administered internally and at the same time applied to the skin arrests the disease and promotes cicatrization of the ulcerating surfaces. In order to test the correctness of this statement, large quantities of the Balsam have been distributed by the Indian Government, but as far as we have heard the new treatment has not been a success. Dr. Dougall's directions for carrying out the treatment of leprosy by Garjan Balsam include frequent ablutions with dry earth and water, and strict attention to the hygienic condition of the patient; it seems probable that he has attributed effects to the Balsam which are in reality due to cleanliness and an improved hygienic condition. The method of extracting the Dipterocarpus Balsam was first described by Roxburgh; more recent accounts have been published, but they do not differ in any points of importance from his; shortly, one or more good-sized cavities are cut with an axe in the trunk of the tree about the end of the dry season, a fire is then lighted in them until the wood is scorched; arrangements are next made to catch the Balsam, which exudes very freely. The oil is extracted yearly from the same trees, and according to Roxburgh, a good tree will produce 30 to 40 gallons during the season; the surface of the cavity has to be occasionally cut away and re-burnt. Garjan Balsam has a stimulant action upon mucous membranes, especially that of the urinary tract, during its excretion by the kidneys. Like copaiba it forms a conjugate glycuronic acid in the system which appears in the urine, and with nitric acid gives a precipitate of gurjanic acid easily mistaken for albumen, but distinguished by its disappearing on the application of heat. The conjugate acid renders the urine antiseptic and prevents the development of bacteria.

Description.—The freshly-drawn Balsam is an opaque, grey fluid, which when placed in the sun gradually separates into two portions, the upper of which is a thick, viscid fluid of a dark reddish brown colour, and transparent when placed

between the eye of the observer and the light, but when viewed by reflected light it is opaque, greenish, and fluorescent. The lower stratum consists of a thick, dirty white magma, and is generally rejected, although it is said to have the same medicinal properties as the clear Balsam. The latter has a feeble copaiba odour, and a bitter aromatic taste; its specific gravity at 16·9° C. is ·964; it is soluble in pure benzol, cumol, chloroform, bisulphide of carbon, and essential oils, and partially so in methylic, ethylic, or amylic alcohol, in ether, acetic ether, glacial acetic acid, carbolic acid, or caustic potash dissolved in absolute alcohol; at about 130° C. it becomes gelatinous, and on cooling does not recover its fluidity.

Chemical composition.—The following account by Fluckiger and Hanbury is taken from the *Pharmacographia* :—"Of the Balsam 6·99 grammes dissolved in benzol and kept in a water bath until the residue ceased to lose weight, yielded 3·80 grammes of a dry, transparent, semi-fluid resin, corresponding to 54·44 per cent., and 45·56 of volatile matters expelled by evaporation.

"By submitting larger quantities of the Balsam to the usual process of distillation with water in a large copper still, 37 per cent. of volatile oil were easily obtained. The water passing over at the same time did not redden litmus paper; a dark viscid, liquid resin remained in the still.

"The essential oil is of a pale straw colour, and less odorous than most other volatile oils; treated with chloride of calcium and again distilled it begins to boil at 210° C., and passes over at 260° C., acquiring a somewhat empyreumatic smell and light yellowish tint. The purified oil has a sp. gr. of 0·915 to 0·914, it is but sparingly soluble in absolute alcohol or glacial acetic acid, but mixes readily with amylic alcohol. According to Werner, this oil has the composition $C^{10}H^{16}$, like that of copaiba. He says it deviates the ray of polarised light to the left, but that prepared by one of us deviated strongly to the right, the residual resin dissolved in benzol being wholly inactive. The oil does not form a crystalline compound with dry hydrochloric

acid which colours it of a beautiful blue. DeVrij states that the essential oil after this treatment deviates the ray to the right.

"The resin contains, like that of copaiba, a small proportion of a crystallizable acid, which may be removed by warming it with ammonia in weak alcohol. That part of the resin which is insoluble even in absolute alcohol, we found to be uncrystallizable. The gurjunic acid may consequently be prepared by extracting the resin with alcohol (·838) and mixing the solution with ammonia. From the ammoniacal solution, gurjunic acid is precipitated on addition of a mineral acid, and if it is again dissolved in ether and alcohol it may be procured in the form of small crystalline crusts. Gurjunic acid, $C^{44} H^{64} O^{8}$, according to Werner, melts at 220° C. and concretes again at 180° C., it begins to boil at 260° C., yet at the same time decomposition takes place. By assigning to this acid the formula $C^{44} H^{61} O^{5} + 3 H O$, which agrees well with Werner's analytical results, we may regard it as a hydrate of abietinic acid, the chemical behaviour of which is perfectly analogous. Gurjunic acid is soluble in alcohol 0·838, but not in weak alcohol; it is dissolved also by ether, benzol, or bisulphide of carbon.

"In copaiba from Maracaibo Strauss discovered metacopaivic acid, which is probably identical with gurjunic, the former however fuses at 206° C. The amorphous resin forming the chief bulk of the residue of distillation of the balsam has not yet been submitted to exact analysis. We find that after complete dessication it is not soluble in absolute alcohol." Flückiger has since discovered (1878) in Garjan Balsam a crystallizable indifferent resin formula $C^{28} H^{46} O^{2}$, it melts at 258·8° F. and dissolves in sulphuric acid with an orange colour.

Commerce.—Garjan Balsam is not an article of commerce in most parts of India, but small quantities may be sometimes obtained in the native drug shops. In Calcutta its price is from 3 to 5 rupees per maund of 80 lbs. Large quantities are exported from Moulmein to Europe. The Government supplies have been obtained from the Andaman Islands.

SHOREA ROBUSTA, *Gærtn. f.*

Fig.—*Beddome Fl. Sylv. t.* 40. The Saul tree (*Eng.*).

Hab.—Tropical Himalaya, Central India, Western Bengal. The resin.

Vernacular.—The resin, Ral, Dhuna (*Hind.*, *Beng.*, *Mar.*), Kungiliyam (*Tam.*), Guggilamu (*Tel.*), Guggala (*Can.*).

History, Uses, &c.—The Sal tree, called in Sanskrit Sala and Asvakarna, is of interest from a mythological point of view, as the mother of Buddha is represented as holding a branch of the tree in her hand when Buddha was born, and it was under the shade of a Sala tree that Buddha passed the last night of his life on earth. The small branches of the Sala are used by Indian villagers to detect witches; they write the name of every woman over 12 years of age in the village upon a branch; the branches are then placed in water and left for 48 hours; if any woman's branch withers she is the witch.

This tree is very widely distributed throughout India, and is undoubtedly the source of the Resin or Ral of Hindu and Mahometan writers on Materia Medica. Ral, in Sanskrit Rala and Sal-veshta, is regarded by the Hindus as attenuant, detergent, and astringent, and is sometimes prescribed internally mixed with sugar, honey or treacle; as resin does with us, it enters into the composition of stimulating plasters and ointments; it is also used for fumigating rooms occupied by the sick. The seeds of the Saul tree are eaten in times of scarcity with Mahwa flowers by the wild tribes of India. Mahometan writers give a similar account of its properties and uses. The author of the Makhzan-el-Adwiya (*vide* article Kahruba) notices the fact that more than one kind of Rál is met with, but names the Sakoh or Sál as the source from which the genuine article is obtained. In another part of his work (*vide* article Sakoh) he describes the tree, and says that when old the bark becomes separated from the trunk by the deposit of Rál beneath it. Ainslie mentions three kinds of resin or dammar as common in the bazars of Southern India, but is in doubt as to the sources from

whence the different kinds are obtained. He observes that a great portion of the dammar used in India is imported from Java, Borneo, Joanna, and several of the Soloo Islands. The author of the Bengal Dispensatory, after conducting a series of experiments with genuine Sál resin, pronounced it to be an efficient substitute for pine resin. In Bombay, at the present time, American rosin is to a great extent displacing Indian Rál. Dr. Sakharam Arjun states (*Bomb. Drugs*) that he has seen Shorea resin mixed with sugar, given with good effect in dysentery. The oil of the seeds is extracted in Malabar. In the Wynaad *Shorea Talura, Roxb.* (*S. laccifera, Heyne,*) yields a fragrant resin, known as *Sambrani*, which is burnt as an incense.

Description.—Rál varies in colour from dark brown to pale amber; it is devoid of taste and smell; sp. gr. 1·097 to 1·123, easily fusible, partially soluble in alcohol (83·1 per 100), almost entirely in ether, perfectly in oil of turpentine and the fixed oils; sulphuric acid dissolves and gives it a red colour. By dissolving the resin in oil of turpentine and boiling it with a solution of potash until all the turpentine was expelled, O'Shaughnessy obtained a compound of resin and potash entirely soluble in water. The seeds have been examined by Church with the following result:—Water 10·8, albumenoids 8·0, starch 62·7, oil 11·8, fibre 1·4, ash 2·3 in 100 parts.

Commerce.—Rál is imported into India from Singapore in casks and bales. Value, Rs. 6 per cwt.

VATERIA INDICA, *Linn.*

Fig.—*Beddome Fl. Sylv., t. 84; Wight Ill. i. 88, t. 36.* Piney tallow tree (*Eng.*).

Hab.—Western Peninsula. The resin and fat.

Vernacular.—The tree, Dúpada; the resin, Vellai-kungiliyam (*Tam.*)

History, Uses, &c.—The resin known as Vellai-kungiliyam has long been used by the natives of Southern India

as an incense, and for making varnishes. It is obtained by cutting notches in the tree, when it exudes and gradually hardens. Specimens differ much in colour, fragrance and density; some being of a light greenish colour, dense, homogeneous and vitreous on fracture; whilst others are amber-coloured, and vesicular. These differences apparently arise from the mode of collection; and the age of the trees producing them. It burns with a clear, steady light, giving off a pleasant smell, but very little smoke. With the aid of heat, and the addition of a small portion of camphor, it is soluble in spirit. Under the influence of gentle heat it combines with wax and oil; and forms an excellent resinous ointment. (*Dr. G. Bidie in Pharmacopœia of India.*) Vateria seeds yield a vegetable butter, known as the *Piney tallow* of Canara, or Malabar; this fat has a considerable reputation as a local application in chronic rheumatism, and might be used as a basis for ointments where increased consistency is required. It closely resembles the solid fats of *Garcinia* and *Bassia*, and like them consists chiefly of solid fatty acids. It would, no doubt, be valuable in the preparation of nitrate of mercury ointment. (*See article on Garcinia indica.*)

Chemical composition.—The seeds have been examined by M. M. Hohnel and Wolfbauer, who found that when air dried they afforded 49·2 per cent. of a greenish-yellow, solid fat, which bleaches rapidly on exposure to light and has a peculiar agreeable balsamic odour. This fat rapidly saponifies, and consists of a mixture of fatty acids melting at 56°·6 and solidifying at 54°·8 C. The mixture contains oleic acid, and 60 per cent. of a solid fatty acid melting at 63°·8. (*Chem. Centr.; Journ. de Pharm. et de Chim.; Journ. Chem. Soc.,* 1886.)

DRYOBALANOPS AROMATICA, *Gärtn.*

Fig.—*Hook. Journ. Bot.,* 1852, *t.* 7; *Hayne xii., t.* 17. Borneo Camphor (*Eng.*).

Hab.—Sumatra, Borneo.

Vernacular.—Bhimsénú Kápúr or Káfúr (*Hind., Bomb.*).

History, Uses, &c.—Sanskrit writers mention two kinds of camphor, *Pakva* and *Apakva* (cooked and uncooked); it is generally considered that Borneo camphor is meant by the latter term. In the Rájanirghantu oil of camphor is mentioned; this may refer to the Borneo camphor oil, or to some preparation made by dissolving camphor in oil. Mahometan writers describe the Borneo camphor as the best kind, and notice the way in which it is obtained by splitting the trunk of the tree. The author of the Makhzan-el-Adwiya gives a full account of it, and mentions the fact of several pieces of the timber having been brought to the Hughli, which when cut up into planks yielded a quantity of camphor. He also describes the way in which the oil is obtained by incising the tree. Borneo camphor is supposed by native physicians to have the properties of camphor in a much higher degree than ordinary camphor; on this account it fetches an extraordinarily high price. From the researches of Flückiger and Hanbury it appears that this camphor was the only kind known in Europe in the Middle Ages and was the καφουρά of the later Greek writers, who obtained their knowledge of it from the Arabians. Camphor is considered by the Hindus to be hot and dry, and by the Mahometans to be cold and dry, and to stimulate the brain and heart; it is prescribed in a great variety of disorders. The Hindus consider Borneo camphor to be aphrodisiacal, but the Mahometans hold a contrary opinion; both regard it as a valuable cooling application to the eyelids in inflammatory conditions of the eye. Ainslie mentions the Dryobalanops camphor as having been recently described by Mr. H. T. Colebroke, who was the first to determine its Botanical source, but wrongly supposes it to be the chief source of the camphor used in India. Mr. John Macdonald (1793) described the collection of the camphor in Sumatra in the following terms:—"The Sumatrians previous to their setting out in search of camphor discharge a variety of religious duties and ceremonies. They select old trees and pierce them, if they yield oil plentifully it

is presumed they contain concreted camphor, which is found in small whitish flakes, situated perpendicularly in irregular veins, in and near the centres of the trees. The tree is cut down, divided into junks and carefully divested of its camphor. The camphor is repeatedly washed and soaked in soapy water to clean it. When clean it will sink in water, and have a white glossy smooth appearance, tending to transparency. After washing it is passed through three sieves of different mesh, so as to be divided into head, belly, and foot camphor: certain proportions of each compose the chests made up for the China market, where they are sold for £350 sterling nearly. An inferior kind is made by boiling down the liquid oil. Sumatra affords annually from 15 to 20 peculs of 133⅓ lbs. each, and more oil than there is at present a demand for." (*As. Researches, &c.,* 19.) Flückiger and Hanbury in the *Pharmacographia* say:—"The produce of a single tree does not, it is supposed, often exceed 11 lbs. A good proportion of the small quantity produced is consumed in the funeral rites of the Batta princes. The camphor which is exported is eagerly bought for the China market, but some is also sent to Japan, Laos, Cochin China, Cambodia and Siam." In India it is chiefly used by the Jains to prepare an *Abir* or sacrificial powder called *Vasakshepa*; this powder consists of sandal-wood, saffron, Borneo camphor and musk.

Dr. Stockman has proved that Borneo camphor has exactly the same physiological action as laurel camphor. He points out that laurel camphor, borneol and menthol form a group of substances very closely allied to each other in physiological action, borneol resembling very nearly monobromide of camphor in this respect. All are closely related to the alcohol group in their physiological effects, menthol approaching the latter most nearly; but as the number of hydrogen atoms diminishes there is an increased tendency to convulsions of cerebral origin. Borneol and menthol however differ from pure ethylic alcohol in powerfully dilating the peripheral vessels. Borneol is also a less irritating substance locally

than laurel camphor, and can be given in much larger doses than the latter without causing untoward cerebral symptoms.

Description and chemical composition.—Borneo camphor, also termed by chemists Borneol or Camphyl alcohol, is somewhat harder than common camphor, also a little heavier, so that it sinks in water. It is less volatile, and does not crystallize on the interior of the bottle in which it is kept; and it requires for fusion a higher temperature (198° C.). It has a somewhat different odour, resembling that of common camphor, with the addition of patchouli or ambergris. The composition of Borneol is represented by the formula $C^{10} H^{18} O$. It may be converted by the action of nitric acid into common camphor; conversely, as Berthelot has shown, Borneol may be prepared from common camphor by heating the latter with alcoholic potash. The artificial Borneol has the same composition as the natural article, but differs in optical power, and has therefore been termed Camphol. (*Pharmacographia.*) An alcoholic solution of Borneol examined by Dr. Lyon of Bombay proved to be 12½° dextrogyre. Besides camphor, the Dryobalanops furnish a liquid termed camphor oil, which must not be confounded with the camphor oil that drains out of crude laurel camphor. This Bornean or Sumatran Camphor oil is called Borneone, and is isomeric with oil of turpentine, $C^{10} H^{16}$, yet in the crude state, holding in solution Borneol and resin. By fractional distillation it may be separated into two portions, the one more volatile than the other, but not differing in composition. (*Pharmacographia.*)

According to Dr. Beckman laurel camphor may be converted into Borneo camphor in the following manner:—The camphor is dissolved in ether or some other solvent indifferent to the action of sodium, and repeatedly treated with sodium and then with water. The reaction is shown by the equation—

$$2\ C^{10} H^{16} O + Na = C^{10} H^{15} Na O + C^{10} H^{17} Na O.$$

These sodium compounds are decomposed by water with the formation of molecular quantities of camphor and borneol.

$C^{10} H^{15} . Na O + C^{10} H^{17} . Na O + 2 H^2 O = C^{10} H^{16} O + C^{10} H^{18} O + 2 Na O H.$

The solution of camphor and borneol so obtained is treated afresh with sodium and water until all the camphor is converted into borneol.

Commerce.—The quantity annually shipped from Borneo was reckoned by Motley in 1851 to be about 933 lbs., the export from Sumatra was estimated by De Vriese at 10—15 quintals per annum. The quantity imported into Canton in 1872 was returned as 3,159 lbs., value 42,320 taels, equivalent to about 80*s*. per lb. In the Annual Statement of the Trade of Bombay for the year 1872-73, 2 cwts. of Malayan camphor is stated to have been imported; it was valued at Rs. 9,141. The price in Borneo in 1851 of camphor of fine quality was 30 dollars per catty, or about 95*s*. per lb. (*Pharmacographia.*) At the present time, good Borneo camphor is worth in India Rs. 100 per lb.; an inferior quality is sold at from Rs 70—80 per lb. An alcoholic solution of the latter examined by Dr. Lyon was about 2½° lævogyre, on this account he thinks it must be a mixture of Borneo and Ngai camphor, the product of *Blumea balsamifera* (For a description of which, see *Pharmacographia.*)

MALVACEÆ.

ALTHÆA OFFICINALIS, *Linn.*

Fig.—*Bentl. and Trim., t.* 35. Marsh Mallow (*Eng.*), Guimauve (*Fr.*).

Hab.—Temperate climates. The flowers, carpels, leaves and root.

Vernacular.—The flowers, Gul Khairu (*Pers., Ind.*); the carpels, Tukm-i-Khitmi (*Pers., Ind.*); the root, Rishah-i-Khitmi (*Pers., Ind.*).

History, Uses, &c.—A plant called Althæa is mentioned by Dioscorides,* and was held in great esteem by the Greeks and Latins † on account of its healing properties. Theophrastus says of Althæa, καὶ ἣν οἱ μὲν ἀλθαίαν, ἐκεῖνοι δὲ μαλάχην ἀγρίαν καλοῦσι. Some consider the althæa of Theophrastus to have been *Lavatera arborea* (the tree mallow), but as it is described as having yellow flowers (*iv.*, 19,) this cannot be correct. Perhaps *Abutilon Avicennæ, Gärtn.*, was the plant. The Mahometans describe *Khairu* as a suppurative and emollient; they use the leaves as a poultice and for fomentations; mixed with oil the leaves and flowers are applied to burns and parts bitten by venomous reptiles. The root boiled with sugar is prescribed in coughs and irritable conditions of the intestines and bladder. The decoction is also used as an emollient enema, and in making ointments; in short, with the Mahometans it is as important an article of the Materia Medica as with the French and other Continental nations in Europe. Althæa is demulcent and emollient; its action is mechanical, inasmuch as it forms a soft smooth covering to the inflamed or irritated parts with which it comes in contact and thus protects them from friction, and allows the process of repair to go on undisturbed.

Description.—The different parts of the plant used in India are imported from Persia. The flowers have by some been attributed to *A. rosea*, but the carpels which may be found mixed with them, have not the membranaceous margin of that plant, and the exterior calyx has from 8 to 9 divisions instead of 6. The calyx is thick, and covered with simple hairs, very closely set, and arranged in star-like tufts; the flower has five petals, which in the dry article are bluish green at the base, the blades being purple; both calyx and flowers are mucilaginous. The root appears to be the same as the European article, but it is not decorticated, nor is it so plump and free from fibre. The carpels are large and pubescent, and are known as Tukm-i-khitmi.

* Dios. iii., 154.

† Pliny 20, 84.

Microscopic structure.—The cortex of the root is chiefly liber; the parenchyme consists partly of starch and partly of mucilage cells; stellate raphides may be seen. The central portion is composed of wood cells, scalariform and pitted vessels, and parenchymatous tissue

Chemical composition.—According to Flückiger and Hanbury, the mucilage in the dry root amounts to about 25 per cent. and the starch to as much more. The former appears to agree with the formula $C^{12}H^{20}O^{10}$, thus differing from the mucilage of Gum Arabic by one molecule less of water It likewise differs in being precipitable by neutral acetate of lead; at the same time it does not show the behaviour of cellulose, as it does not turn blue by iodine when moistened with sulphuric acid, and it is not soluble in ammoniacal solution of oxide of copper. The root also contains pectin and sugar, and a trace of fatty oil Tannin is found in very small quantity in the outer bark alone Marshmallow root contains from 0·8 to 2·0 per cent. of asparagin, which is a widely diffused constituent of plants; it crystallizes in large prisms or octohedra of the rhombic system, and is tasteless and apparently destitute of physiological action. The peeled root dried at 100° C. and incinerated affords 1·88 of ash, rich in phosphates. (*Pharmacographia.*)

Commerce.—The flowers, carpels and root are imported from Persia, Value, flowers, 2 annas per lb.; seeds, 4 annas; root, 4 annas.

In connection with this drug may be mentioned the Althéa of the Portuguese at Goa, a substitute for Althæa; it is the root of *Grewia scabrophylla, Roxb.* The drug consists of the young roots, the largest being about as thick as the little finger. They are straight, unbranched, and have a thin brown cortex covering a thick white parenchyma; in which are seen well marked yellowish medullary rays, spreading from a tough, woody, central column, the diameter of which is less than the semi-diameter of the white portion; examined under the microscope most of the cells of the parenchyme are seen to be

filled with starch granules; but some large ones contain mucilage only. The central woody column abounds in large pitted vessels Soaked in water the root gives out abundance of mucilage having a faintly bitter taste. When properly scraped and dried it is very white and apparently an efficient substitute for the imported article.

The roots of *Hibiscus Rosa sinensis*, Shoe-flower (*Eng.*), Ketmie de Cochin-Chine (*Fr.*), the Jásund or Jásus of Bombay, the Java of Hindustan, Shappathupu of Madras, Foulsapattes of the French Creoles, and Java or Japa of Sanskrit writers, are also dried and sold in the shops as a substitute for Althæa. In the Concan the fresh root-juice of the white flowered variety is given in doses of two tolás with milk, sugar and cummin for gonorrhœa, and the root powdered is given with an equal quantity of Lotus-root and the bark of *Eriodendron anfractuosum* in the same manner for menorrhagia, the dose of the three being 6 massas. This shrub is the Flos festalis of Rumphius (vi., II.), who relates the confession of a native of Banda in 1655 that he had caused the abortion of his concubine by giving her the flowers rubbed down with Papaya seeds. He says they are popularly considered to be emmenagogue in Amboyna. In India the Papaya is considered an abortifacient, but not the flowers of *H. Rosa sinensis*; the notion is evidently a fanciful one, and connected with their red colour.

MALVA SYLVESTRIS, *Linn.*

Fig.—*Eng. Bot.* 671. Common Mallow (*Eng.*), Mauve sauvage (*Fr.*).

Hab.—Temperate climates. The fruit.

Vernacular.—Khubázi (*Arab.*, *Ind.*).

History, Uses, &c.—This plant, or *M. rotundifolia*, is generally supposed to have been the μαλαχη of Dioscorides,*

* Dios., ii., 109, who says that Zoroaster called it Diadesma and the Egyptians Khokorteen. Prosper. Alpinus describes and figures *Corchorus olitorius* as Melochia Theophrastus, H P. I, 4, describes Malache as a shrub; his plant may hav

which was used by both Greeks and Romans as a medicine on account of its mucilaginous and cooling properties. It is the Nán-i-kulagh, "crow's-bread," and Khitmi-i-kuchak, "small Khitmi" of the Persians. Mauláná Nafis describes three kinds of malokhia, *viz.*:—

1*st*, A cultivated kind called Malokhia.

2*nd*, A large wild kind called Khitmi.

3*rd*, A small wild kind called Khubázi.

The author of the Makhzan-el-Adwiya pronounces the last mentioned to be the article known as Khubázi, and describes it thus: - "Leaves roundish, tasteless, a little hairy on the under surface; flower small, reddish purple; fruit round and flat, depressed in the centre, colour white or brown. The plant is much smaller than Khitmi." All parts of this plant are commended in Mahometan works on account of their mucilaginous and cooling properties, but the fruit is considered to be most efficient. Pliny, quoting Xenocrates, says that the seeds are aphrodisiacal, and such would appear to be the opinion of the Mahometans of India. In modern medicine the common mallow is considered to have properties similar to Althæa.

Description.—The fruit consists of from 10—12 glabrous wrinkled carpels, each containing one reniform seed; some of it is mature, but at least half is in various stages of immaturity, a portion of the thin papery calyx is attached to the fruit, and in a good fresh sample a few deep blue flowers may be found as well as the peduncles and portions of the leaf. Some seed planted in Bombay in June grew freely, and produced strong flowering plants in the rainy season.

Chemical composition.—Water dissolves the mucilage and a little bitter extractive.

Commerce.—The fruit is imported from Persia under the name of Khubázi. It is worth Re. ¼ per lb.

SIDA CARPINIFOLIA, *Linn.*

Fig.—*Wight Ic.*, t. 95, *Hort. Mal.* x., 53.

SIDA RHOMBIFOLIA, *Linn.*

Fig.—*Cav. Diss. I.*, t. 3, *f.* 12.

SIDA CORDIFOLIA, *Linn.*

Fig.—*Dil. El.* 171, *f.* 209.

SIDA SPINOSA, *Linn.*

Fig.—*Cav. Diss. I.*, t. 1, *f.* 9.

Hab.—The tropics generally. The roots.

Vernacular.—*S. carpinifolia, rhombifolia* and *cordifolia*, Bariára (*Hind.*), Bala, Janglí methí (*Guz.*), Tupkada, Tukati, Chikana, Páta (*Mar.*), Malaitangí, Mayir-manikkam (*Tam.*), Chittamuttí, Mayir-manikkam (*Tel.*), Svet-berela, Koreta, Bon-methi (*Beng.*). *S. spinosa*, Gulsakari (*Hind.*).

History, Uses, &c.—The plants belonging to this genus are known in Sanskrit by the general name Bala. Five kinds of Bala are mentioned by Sanskrit medical writers under the name of *Pancha-bala*, viz., Bala, Nágabala, Mahabala, Atibala and Rajabala. The Hindus regard the roots of the different species of Sida as cooling, astringent and tonic; they prescribe them in nervous and urinary diseases, and in fever. The root bark is beaten up with milk and sugar, and aromatics and stimulants are sometimes added. (*For original prescriptions, see Dutt's "Hindu Materia Medica,"* p. 121.) In the Concan the leaves of *S. cordifolia* (Chikana) with other cooling leaves are applied in ophthalmia; the root-juice is used to promote the healing of wounds, and the juice of the whole plant pounded with a little water is given in ¼ seer doses for gonorrhœa. The root of *S. carpinifolia* (Tupkada) is applied with sparrow's dung to burst boils. The Mahometans consider Bala to be aphrodisiac. Ainslie notices several species of Sida,

and the uses to which they are applied by the Hindus. The author of the Bengal Dispensatory, after a trial of the roots of *Sida carpinifolia*, was unable to satisfy himself as to its febrifuge action, but it was found to promote perspiration, to increase the appetite, and to act as a useful bitter tonic. In Goa the Portuguese value it as a diuretic, especially in rheumatic affections; they also use it as a demulcent in gonorrhœa. In Pudukota the plant of *S. humilis*, *Willd.*, is ground with onions and administered for gonorrhœa Its Tamil name is Pelambaci. *S. rhombifolia* is called in Australia "Queensland Hemp," and in N.-S. Wales "Lucerne," as cows are very fond of it. It is also called "Jelly-leaf" on account of its mucilaginous nature. In the various species of Sida we have demulcent and emollient properties combined with bitterness.

Description.—The roots of the different species of Sida are about ½ of an inch in diameter at the stock, woody, and fibrous. The bark is of a light yellowish brown colour; unless the leaves are attached they cannot be distinguished with any certainty. In Western India, *S. carpinifolia* and *S. cordifolia* are most used. The first has smooth lanceolate, serrated leaves; the second cordate, tomentose leaves.

Chemical composition.—The root of *S. carpinifolia* strikes a blue colour with salts of iron, does not precipitate gelatine, yields to boiling water 23 and to alcohol 19 per cent.; it contains asparagin.

Commerce.—None of the roots are articles of commerce.

ABUTILON INDICUM, *G. Don.*

Fig.—*Wight Ic.*, *t.* 12. Country Mallow (*Eng.*).

Hab.—Tropical India, Ceylon. The bark, leaves, and seeds.

Vernacular.—Kanghí (*Hind.*), Petári, Madmi, var *tomentosum*, Chakra-bhenda (*Mar.*), Tuboeuty (*Goá.*), Tutta (*Tam.*) Kápáta, Dábali (*Guz.*). The seeds, Balbij (*Hind.*, *Bomb.*)

History, Uses, &c.—There are several varieties of this plant, the most remarkable being a tomentose, hoary variety, which produces the Balbij of the shops, and another with purple stems called Kali kanghi in Hindustani and Koran-tutti in Tamil. The leaves, bark and seeds would seem to have been long in use among the Hindus on account of their mucilaginous and diuretic properties. Under the names of Másht-el-ghoul and Deshár, short notices of the plant may be found in Arabic and Persian books. Ainslie's *Sida Mauritiana* is evidently identical with it. The bark is valued as a diuretic, and the seeds on account of their demulcent and mucilaginous properties. *A. indicum* is very common on waste ground, and appears to flourish in poor soil, and requires but little water. Ibn Sína mentions a drug called Abútílún ابوطيلون which was applied to wounds, but as he likens it to a Pumpkin it must have been quite different from the plants now known as Abutilon, unless his meaning is that the fruit resembles a miniature pumpkin in shape; in which case *Abutilon Avicennæ, Gärtn.*, may have been the plant.

Description.—The bark occurs in long, thin, tough, fibrous strips, which are very strong; externally it is striated and covered by a cinnamon-coloured epidermis, internally it is white and striated; the striæ are produced by small interspaces between the fibrous bundles of which the bark is chiefly composed. The taste is feebly astringent and bitter. The seeds of the tomentose variety are reniform, about 1-10th of an inch long, and nearly as broad at the larger end, three in each carpel; testa very hard, dull brown, covered with simple hairs, rising from a conical base, which is attached to the testa by radiating processes like roots. The following is a description of the plant obtained by sowing the Balbij of the shops:—Shrubby, hoary, covered all over with a dense silky tomentum of simple hairs; leaves cordate, unequally and sharply serrated; calyx 5-cleft; pedicels axillary, jointed near the flowers, which are of an orange-colour, and open in the evening; capsules truncated, longer than the calyx: carpels about twenty, not awned, hairy on the dorsum. (*A. muticum, G. Don.*)

Chemical composition.—The leaves contain a large quantity of mucilage precipitable with neutral plumbic acetate and ferric chloride, a little tannin or organic acid not affected by gelatine solution, and traces of asparagin. During the ignition of the dried leaves ammonia is evolved in some quantity, and when completely burnt, over 16 per cent of white mineral residue is left. Nearly half the ash consists of alkaline sulphates and chlorides, and the remainder of magnesium phosphate, calcium carbonate and sand.

Commerce.—The seed is sold by all druggists Value, Rs. 6 per Surat maund of 37½ lbs.

HIBISCUS ABELMOSCHUS, *Linn*

Fig.—*Wight Ic.*, *t.* 399. Musk Mallow (*Eng.*), Ketmia Ambrette (*Fr.*).

Hab.—Most tropical countries. The seeds.

Vernacular.—The seeds. Mishk-dánah, Mishk-bhendi-ke-bij (*Hind.*), Kasturi-benda-vittulu (*Tel.*), Kattuk-kasturi (*Tam.*), Kasturi-dána (*Beng.*), Kasturi-bhenda-che-bij (*Mar.*).

History, Uses, &c.—These aromatic seeds are regarded by the Hindus as cooling, tonic and carminative. Arabic and Persian writers notice them under the name of Mishk-dánah, and describe them as Indian, and especially abundant in Bengal; they consider them to be cold and dry, and to have stomachic and tonic properties. The author of the Makhzan-el-Adwiya recommends a mucilage prepared from the root and leaves of the plant in gonorrhœa. The seeds are noticed by Ainslie, who states that in Arabia they are mixed with coffee. He suggests their use as a perfume. Abelmoschus is a corruption of the Arabic name, Hab-el-mishk. The seeds (grains d' ambrette) are largely imported into France from the West Indies by perfumers, who use them as a substitute for musk.

Description.—The seeds are brown, about 2 lines long, kidney-shaped, slightly compressed, marked with minute parallel elevated lines; they have a small distinct hilum; the odour is purely musky.

Chemical composition.—M. Bonastre, who analysed the seeds, found them to consist of parenchyme and moisture 52, gum 36; alumen 5·6, and fixed oil, solid crystalline matter, odorous principle and resin 6·4 per cent. The fixed oil was greenish yellow, fluid at 32° Fahr., but solidified gradually by exposure to the air. The solid crystalline matter was deposited from the hot alcoholic solution of the seeds; it was white, pearly, of a pleasant taste, soluble in ether, from which it crystallized in rays, fusible at 95° Fahr. The odorous mattter was a light green fluid with a strong smell of musk; it was not volatile.—(*Journal de Pharmacie*, Vol. xx., p. 881.) Messrs. Schimmel of Leipzic give the following description of musk seed oil:—Specific gravity ·900 at 25° C., it solidifies at a temperature below 10° C., and contains a free fatty acid which partially separates even at the ordinary temperature. This acid is not myristic, but probably palmitic acid. In the distillation the oil partially decomposes; the distillate is strongly acid and contains free acetic and fatty acid. The oil after being freed from the fatty acid remains liquid at 0° C. (*Report, October*, 1887.)

Commerce.—The seeds do not appear to be exported from India; those from the W. Indies fetch about 6 pence per lb, at Mincing Lane.

HIBISCUS CANCELLATUS, *Roxb.*,
var. *esculentus, Linn.*

Fig.—*Bentl. and Trim.*, *t.* 30. Esculent Okro, Gombo (*Eng.*), Ketmia comestible (*Fr.*).

Hab.—Cultivated in all tropical countries. The fruit.

Vernacular.—Rám-turai (*Hind.*), Bhenda (*Mar.*), Vendaik-kay (*Tam.*), Dheras (*Beng.*), Bhindu (*Guz.*), Bendekai (*Can.*), Benda-kaya (*Tel.*).

History, Uses, &c.—It is doubtful whether this plant is a native of India. Sir J. Hooker seems inclined to think that it is. By some it is thought to be the Tindisha of Sanskrit writers, but the name Bhinda occurs in Sanskrit and probably refers to this plant. The Arabs and Persians call it Bámiya; according to Ibn Baitar, Abul-Abbas describes its cultivation and use in Egypt as a vegetable. The Egyptians make a kind of polenta of the cooked, dried, and powdered fruit, called Naffé. The author of the Makhzan-el-Adwiya states that it is called in Bengal Vilayatí-palwal, and in Hindustani Bhendí, and that it is in India considered to be aphrodisiac. The modern Bengali name is Dhéras. Palwal is the *Trichosanthes dioica*, the fruit of which is of a somewhat similar shape to that of *H. esculentus*. In like manner a similarity of shape with the fruit of *Luffa acutangula* (Turai) has given rise to the Hindustani name Rámturai. Mahometan writers describe it as cold and moist and beneficial to people of a hot temperament. Roxburgh considers it to be nourishing as well as mucilaginous, and recommends it as a valuable soothing and demulcent remedy in irritation of the throat caused by coughing. In the Bengal Dispensatory a lozenge is recommended. Finally, in the Pharmacopœia of India, the immature capsules have been made official for the preparation of the decoction, which is intended to be used as an emollient, demulcent and diuretic in catarrhal affections, ardor urinæ, dysuria, and gonorrhœa.

Description.—The fresh immature capsules are from 4—12 inches in length, about an inch in diameter at the base, tapering, furrowed, somewhat bristly, particularly at the ridges, which correspond in number with that of the cells and valves, *viz.*, from 5—8, with a single row of smooth round seeds in each cell, abounding in a copious, bland, viscid mucilage, which exists more or less in all parts of the plant.

Microscopic structure.—The hairs of the fruit are peculiar, the base consisting of one large cell, to which a number of small cells are attached; in the middle and outer zone of the pericarp are large cavities filled with mucilage.

Chemical composition.—Popp has examined the fresh capsules. He states that they abound in pectin, starch and mucilage. When dried they afforded from 2—2·4 per cent. of nitrogen, and an ash rich in salts of lime, potash, and magnesia. The ripe seeds gave 2·4—2·5 per cent. of nitrogen; their ash 24 per cent. of phosphoric acid. (*Archiv. der Pharmacie*, CXCV., 1871, 142.)

Commerce.—No part of the plant is an article of commerce in India, but the seeds are kept in the shops for sale to gardeners, &c.

HIBISCUS SUBDARIFFA, *Linn.*

Fig.—*Cav. Diss.* vi., *t.* 198, *f.* 1. Red Sorrell, Rozelle (*Eng.*), Oseille de Guinée, Ketmie acide (*Fr.*).

Hab.—Cultivated in the tropics.

Vernacular.—Patwa (*Hind.*), Lal-ambári (*Mar.*), Civappukay-curai (*Tam.*), Pundi-soppu (*Can.*)

Description.—This plant is cultivated in several parts of India. The fleshy red calyx is used as a fruit, and when dried as an acid article of diet like tamarinds. A jelly not unlike red currant is also made from it. In bilious conditions a diet drink is made by boiling it with water and adding a little salt, pepper, asafœtida and molasses; the French make an astringent syrup with it. The seeds are an excellent food for cattle, and the stems yield tow; the leaves are emollient. The cultivation is attended with very little expense, the seed being sown at the commencement of the rainy reason and the crop ripening at its close. In this plant and in *H. cannabinus* we have the emollient and demulcent properties of the Malvaceæ combined with a large amount of acidity which stimulates and at the same time neutralizes the bilious excretion.

Chemical composition.—The dried calices yielded to analysis —Water [illegible]·29, watery extract 65·96, cellulose 7·68, insoluble

ash 3·88, soluble ash 2·44, alkalinity of soluble ash as potash ·75, tartaric acid 9·90, remaining free acid as malic acid 15·54—total free acid per 100 parts dry substance 27·44. (*Lyon*, 1882.)

HIBISCUS CANNABINUS, *Linn.*

Fig.—*Roxb. Cor. Pl.* i., *t.* 190. Hemp-leaved Hibiscus (*Eng.*), Ketmia à feuilles de Chanvre (*Fr.*).

Hab.—Western India. Cultivated in most tropical countries.

Vernacular.—Ambarí (*Mar.*), Pátsan, Rattiasan (*Hind.*), Mesta-pát (*Beng.*), Palungi, Pulichakirai (*Tam.*), Goukura (*Tel.*), Holada (*Can.*), Sujjádo (*Sind.*).

Description, Uses, &c.—The plant is extensively cultivated for its fibre (Dakhani hemp), and the leaves are used as a pot-herb. One tola of the juice of the flowers, with sugar and black pepper, is a popular remedy for biliousness. The seeds of this plant yield an edible oil, and would appear to be the Hab-el-zalim of Persia. Haji Zein describes the plant which produces them as like hemp, having white flowers like a mallow with purple stamens, pod prickly, seeds like cardamom seeds, with a black skin and white kernel. He says they are aphrodisiac and fattening. There are two other kinds of Hab-el-zalim, *viz.*, Artichoke seeds, and the fruit of *Habzelia æthiopica*, the Hab-el-zalim of Serapion or Monkey Pepper, formerly used as a substitute for pepper.

THESPESIA POPULNEA, *Corr.*

Fig.—*Wight Ic.*, *t.* 8; *Bedd. Fl. Syl.*, *t.* 63. Portia tree (*Eng.*), Thespésia à feuilles de peuplier (*Fr.*).

Hab.—Tropical shores of Bengal, Ceylon, and both Peninsulas. The bark and fruit.

Vernacular.—Páras-pipal (*Hind.*), Bhendi (*Mar.*), Purasha-maram (*Tam.*), Kandarola-mara (*Can.*), Gangareun-chettu (*Tel.*), Porásh (*Beng.*), Párasa-piplo (*Guz.*).

History, Uses, &c.—This tree is much valued on account of the toughness of its timber, which is used for carriage building. It is the *Hibiscus populneus* of Rumphius (III. 31), who speaks highly of the value of the heart-wood as a remedy in bilious attacks and colic, and in a kind of pleurodynia from which the Malays often suffer. The fruit abounds in a viscid yellow juice of the colour of gambege, which the natives use as an external application in psoriasis. The leaves are applied to inflamed and swollen joints. The tree is called in Sanskrit Párisa and Gardhabhánda; it is noticed by Ainslie, who says that a decoction of the bark is given internally as an alterative to the extent of 3—4 ounces twice daily. The author of the Bengal Dispensatory also notices it, but expresses no opinion as to its properties. Several trials with this remedy were made by the Editor of the Pharmacopœia of India in scabies and other cutaneous diseases; in some cases it exercised a favourable influence, but in the majority it was productive of little or no benefit.

According to Brannt (*Animal and Veget. Fats and Oils*) the seeds contain a dark red oil, known as "huile amère" which is stated to be used for medicinal purposes.

Description.—The capsule is about 1¼ inch in diameter, oblong, depressed, scaly, ultimately glabrescent, coriaceous, 4-celled, each cell being divided by a partial dissepiment into two parts; seeds the size of a pea, pilose, cotyledons conduplicate, radicle thick, the capsule abounds in viscid yellow juice, which is contained in lacunæ in the inner soft portion. This juice when mixed with water forms a primrose-coloured emulsion, which is not precipitated by oxalate of ammonia, sulphuric acid, chloride of barium, or subacetate of lead. On the addition of Liq. potassæ and alcohol, the emulsion becomes transparent and retains its yellow colour; on the addition of sulphuric acid to the clear potash solution, the colouring matter separates as a curdy precipitate of a greenish yellow colour which floats upon the surface. The heart-wood is of a purplish-red colour and has a pleasant odour; it is very hard,

but splits readily. It yields hardly anything to water, but forms a deep purplish-red tincture with alcohol, which on evaporation leaves an astringent, brittle extract like kino.

Chemical composition.—The heart-wood of *Thespesia populnea* contains a garnet-red resin which can easily be separated by digesting the wood in diluted alkali and using hydrochloric acid to precipitate it from the filtered solution. The resin is insoluble in water, but perfectly soluble in alcohol, chloroform and the alkalies, and partly in ether and benzol. Its solution in spirit forms a dark greenish-brown colour with ferric chloride, and it is precipitated by lead salts. Water extracts scarcely anything from the wood. It leaves after complete ignition about 3 per cent. of mineral constituents.

BOMBAX MALABARICUM, *DC.*

Fig.—*Wight Ill.*, *t.* 29; *Bedd. Fl. Syl.*, *t.* 82. Red silk-cotton tree (*Eng.*), Bombax de Malabar (*Fr.*).

Hab.—Tropical India. The gum and root.

Vernacular.—Semul, Rakta-semul (*Hind.*), Rokto-semul (*Beng.*), Saur, Sauri (*Mar.*), Mul-ilava-maram (*Tam.*, *Mal.*), Mulluburaga-mara (*Can.*), Mundla-buraga-chettu (*Tel.*), Shemalo (*Guz.*). The gum, Mocha-ras, Supari-ka-phul (*Hind.*, *Bomb.*), Mocha-ras (*Tam.*, *Tel.*, *Can.*).

History, Uses, &c.—*B. malabaricum*, in Sanskrit Sálmali, and Mocha, is a large tree, covered with stout, hard conical prickles, on which account it bears the Sanskrit synonym of Kantakadruma. In the Mahabhárata it is related that Pitámáha after having created the world, reposed under the tree Sálmali, and in the code of Yajnavalkya it is mentioned as one of the trees of the infernal regions (yamadruma), because it makes a great show of flowers, but produces no fruit fit to eat. At the end of the cold season this tree is a very remarkable object, being entirely destitute of leaves, and loaded with large, red, cup-shaped flowers, which are followed

by egg-shaped, green capsules, containing numerous brown seeds having an average weight of 1-5th of a grain, and a quantity of fine silky cotton. Hindu and Mahometan writers state that the root of the young tree (*músla-semul*), when about as large as a carrot, has restorative, astringent and alterative properties; powdered and mixed with sugar, *ghi* and the juice of the fresh root, it is made into a *pák* or confection which has a reputation as an aphrodisiac, and as a restorative in phthisis and other wasting diseases. In some parts of India the root of the white-silk cotton tree (*Eriodendron anfractuosum*) is preferred for this purpose. This tree is the *Lanifera arbor* of Clusius, the pods of which were first brought to Holland about the end of the 16th century; its cotton is the Capock fibre of the Dutch, and the tree, like the Bombax, yields a dark-coloured opaque gum, insoluble in water, which is used as an astringent in bowel complaints. The natives regard *E. anfractuosum* as a variety of the Bombax, and call it Sveta-sálmali or "white Sálmali" in Sanskrit. In Hindi it is Safed-semul, in Marathi Pándhra-saur, in Guzerati Dolo-shemalo, &c., all names which have a similar meaning. In Madras the young fruits are dried and used as a demulcent and astringent. The gum of the Bombax is very astringent, and is used by both Hindus and Mahometans in diarrhœa, dysentery, and menorrhagia in doses of from 40—50 grains for an adult. Sálmali-veshta or Mocha-ras (juice of mocha) only exudes from portions of the bark which have been injured by decay or insects; incisions in the healthy bark produce nothing.

Description.—When first exuded it is a whitish fungous mass, which gradually turns red, and finally dries into brittle mahogany-coloured tears. The larger tears are hollow in the centre, the cavity being produced during the gradual drying of the jelly-like mass which first exudes. Dry Mocha-ras when soaked in water swells up, and resumes very much the appearance of the fresh exudation. The taste is purely astringent like tannin.

Mocha-ras is not a normal juice, but the product of a diseased action, which consists in a proliferation of the parenchyme

cells of the bark; upon making a section of the diseased part, a number of small cavities are seen, which contain a semi-transparent jelly-like substance, consisting of oblong cells containing a little granular matter and a small group of starch cells. At the margin of the cavity the columns of healthy cells are seen breaking up, and the cells separating to join the jelly-like mass; this gradually increases in size and finds its way to the surface to be extruded as Mocha-ras.

The young roots are of a yellowish white colour when the bark has been removed, and are soft, mucilaginous and feebly astringent; grated and mixed with water they yield abundance of nearly colourless mucilage.

Chemical composition.—Mocha-ras when macerated in water affords a reddish-brown solution, which yields a very copious dirty green precipitate with ferric salts, the solution contains a little gum, which is precipitated by alcohol, the bulk of the exudation remains undissolved.

The seeds of *B. malabaricum* yield 25 per cent. of a sweet non-drying oil; it is of a light yellowish brown colour, and commences to deposit fats at 20° C., when it has a specific gravity of 0·9173. The crystalline insoluble fatty acids of the oil amount to 92·8 per cent., and melt at 41°.

The cake of the seeds of *E. anfractuosum* and that of cotton seeds has been examined by Reinders with the following comparative results:—

	Kapok cake.	Cotton cake.
Water	13·28	12·60
Nitrogenous (albuminous) compounds...	26·34	20·62
Fat	5·82	6·36
Non-nitrogenous extractive matter	19·92	35·42
Woody fibre	28·12	20·36
Ash	6·52	5·64

The ash from Kapok cake contains 28·5 per cent. of phosphoric acid and 24·6 per cent. of potash.

Commerce.—Mocha-ras or Supari-ka-phúl* is collected by Bheels and other wild tribes. It is sold by all the druggists. Value, Rs. 4 per Surat maund of 37½ lbs. The gum of Moringa is frequently mixed with Mocha-ras; though similar in colour, it may readily be distinguished by its weight and solidity.

ADANSONIA DIGITATA, *Linn.*

Fig.—*Cav. Diss. v.*, 298, *t.* 15. Monkey Bread tree (*Eng.*), Calebassier (*Fr.*)

Hab.—Africa. Cultivated in India. The fruit, bark and leaves.

Vernacular.—Gorakh-amli, Háthi-khatiyán (*Hind.*), Gorakh-chinch (*Mar.*), Papparappuli, Anaipuliya-maram (*Tam.*), Sumpura (*Guz.*).

History, Uses, &c.—This tree, remarkable for the enormous size of its trunk, was first described by Aloysius Cadamosto, a Venetian, in 1454, from one he saw growing at the mouth of the Senegal river, which measured 112 feet in circumference. At Senegal it is called El-omarah and Oufa, and the fruit El-kongles. Prosper Alpinus figures it, and notices that the powdered pulp was sold as Terra Lemnia to those unacquainted with the genuine article; it was eaten with sugar as a cooling medicine in febrile disorders. (*For an account of Terra Lemnia, see P. Bellonius, Obs. I.*, 28.) At the present time the pulp is a component of certain pastiles famous in Turkey, and supposed to contain this earth. Adanson, whose name the genus bears, and who travelled in Senegal in 1794, saw two trees, from 5 to 6 feet in diameter,

* Supári is the fruit of *Areca Catechu*, but children masticate instead of it the blunt thorns of *B. malabaricum*, to which they give the name of supári. In this way the gum has come to be called *Supári-ka-phul*, which has misled some into supposing Mocha-ras to be the produce of the Areca.

on the bark of which were cut a number of European names; two of these were dated, the one in the 14th, the other in the 15th century. In 1555, the same trees were seen by Thevet, another French traveller, who mentions them in his Travels. Livingstone saw the tree in the neighbourhood of Lake Ngami, where it is called *Mowana*. In India it has been introduced by the Arabians, and is common on the Western Coast and near many Mahometan towns; they call it Bahobab, Habhab or Habhabu. The Indian names Gorakh-amli and Gorakh-chinch, signify Gorakh's tamarind; Gorakh was a celebrated Hindu ascetic. Háthi-khatíyán is Elephant's flax, a name given to the tree on account of the great strength of the fibre prepared from its bark. Mr. A. Rea, of the Archæological Survey of India, describes a curious old tree at Chezala, in the Kistna district, standing in the court of a Buddhist chaitya, which has a hollow core, and is popularly supposed to grow from out of a subterranean cave. It is known as Peruleni-pedda-manu, or "the nameless great tree." Around the base is a platform 25 ft. by 22 ft. 6 in. and 3 ft. high. The circumference of the trunk at that height is 53 ft. 6 in; the first branches are 9 ft. 6 in. from the ground, and there the girth is 56 ft. The spread of the foliage is 73 ft. across; and the height of the tree is about 87 ft. In Africa as in India the shell of the fruit is used for various economic purposes, such as floats for fishing nets, water bottles, &c. In Africa the pulp and seeds are used as a food, and as a medicine in dysentery, and the young leaves, which are very mucilaginous, are made into poultices and used as a fomentation to painful swellings. The leaves dried and reduced to powder are called *Lalo* by the Africans, and are used to check excessive perspiration. The Duchassaings of Guadeloupe have recommended the bark in fever: they say it is cooling, lessens the frequency of the pulse, and increases the appetite. It may be given in decoction, 30 grammes in a litre of water, boiled down to two-thirds. (*Corre et Lejanne. Mat. Med. Coloniale.*) Dr. Rançon in his thesis on "La dyssenterie endémique des pays chauds et notamment au Sénégal" (Faculté de Lyon, 1886,) says "Le

pain de singe est considéré par les indigènes comme le médicament anti-dyssentérique par excellence. Il est mélangé aux aliments mêmes. Ainsi, l'indigène se nourrit surtout de bouillie de farine de mil avec du lait caillé. On désigne ce mélange sous le nom de *Sanglé*. Lorsqu'il est atteint par la dyssenterie, le nègre mélange le pain de singe à cette bouillie."

Dr. Garnier in his thesis "Souvenirs médicaux du poste du Sedhiou (Cazamance)" Faculté de Montpellier, 1888, says of the Baobab: "Il est utilisé dans l'alimentation par les noirs, qui l'ajoutent au couscous; dans la thérapeutique, par les mulâtres, contre la diarrhée ou la dyssenterie. Il nous a été loisible de l'expérimenter plusieurs fois dans la première affection, et si nous n'avons pas relevé d'action efficace bien marquée, nous ne lui avons pas trouvé non plus d'inconvénients. Il nous a paru agir comme substance rafraîchissante, tempérante, *se rapprochant du tartrate de potasse*. Quelque peu de pulpe en macération dans l'eau donne une tisane fort agréable et calme bien la soif, dans la fièvre, par exemple. Ses feuilles sont mucilagineuses et emollientes, on les emploie fraîches ou sèches. Sous cette dernière forme, c'est le *Lalo* des nègres. Etant au bout de notre provision de tourteaux de graines de lin, nous nous en sommes maintes fois servi avec succès, suivant le conseil d'un commerçant de Sedhiou, pour remplacer l'émollient Européen." In India the pulp mixed with buttermilk is used as an astringent in diarrhœa and dysentery. In the Concan the pulp with figs is given in asthma, and a sherbet made of it, with the addition of cummin and sugar, is administered in bilious dyspepsia. It is also given for this affection with emblic myrobalans, fresh mint, rock salt and long pepper. Modern research shows that the pulp is aperient and demulcent, the leaves demulcent with slight astringency and the bark demulcent and astringent, the astringency being due to the presence of tannin.

From an article in the "Bulletin de la Société Philomatique de Paris (1822, p. 103,) it would appear that the pulp of the Baobab was used in Europe up to the commencement of the

present century as a remedy for dysentery. The ash of the pericarp is used in Africa for the manufacture of soap.

Description.—The fruit varies much both in shape and size; some specimens correspond with the description given by Adanson, and others with that of Guibourt, that is to say, they are either cucumber-shaped or bottle-shaped, and from 6 to 18 inches in length. The shell is hard, woody and light, clothed with a dull green felt-like down, composed of simple hairs; it is made up of regularly arranged wood cells intersected here and there by vascular bundles. The fruit is full of sub-acid pulp, which is divided by fibrous bands into a number of compartments. The pulp dries up into a starch-like powder of a reddish-white colour, which adheres together in polyhedral masses, a seed forming the centre of each mass; it consists chiefly of mucilage-cells and contains no starch. The seeds are enclosed in a horny shell, having a rusty-red, rough exterior; they are kidney-shaped and half an inch in length. The bark has a scabrous epidermis, and on section shows a mottled yellowish-green and reddish-brown surface; internally it is intimately united with the woody fibre of the trunk. The fresh bark when wounded yields a white semi-fluid gum, which is odourless and tasteless, and has an acid reaction; it is insoluble in water. The ash contains a large quantity of lime. Mr. J. G. Prebble has brought to our notice that this gum when examined under the microscope is seen to be full of well-formed clustered crystals of calcium oxalate; there are also some highly refractive globules of oil or oleo-resin. With age the gum eventually becomes reddish-brown.

Microscopic structure.—A transverse section of the leaf shows that the upper surface consists of a single row of large cells, which swell when boiled, but develop no mucilage. Beneath this is a parenchyme of cells containing chlorophyll, except over the central nerve, where chlorophyll is absent and the cells are broken down to form a large lacuna or depôt of mucilage; similar cells and smaller lacunæ are seen beneath the nerve to the number of four or five. Over the secondary nerves

there are similar cells and a single lacuna. The rest of the parenchyme is cellular and of no special interest. The lower surface of the leaf is composed of a row of small cells which yield no mucilage on boiling.

A transverse section of the young stem shows an epidermis and scanty suber, beneath which are a number of rows of tangentially extended cells, and then two or three rows of parenchyme cells containing chlorophyll and oil globules, amongst which are some cells containing crystals of calcium oxalate. Next comes a thick liber, in which are groups of stone cells and some cells containing calcium oxalate. The wood is porous, and the pith also shows cells containing oxalate. In the old bark, in the cells beneath the chlorophyll cells, are tangentially extended lacunæ containing mucilage, which absorb a large part of the tissue; the suber and liber are much developed, and large groups of stone cells are seen in connection with the medullary rays. (*Heckel and Schlagdenhauffen.*)

Chemical composition.—Mixed with water and treated with a drop of iodised iodide of potassium, the pulp is not coloured blue or yellow, showing the absence of starch and albumenoid principles, but the water forms a mucilage which, when filtered and treated with alcohol, yields an abundant gelatinous precipitate. It is also precipitated by neutral plumbic acetate, chloride of zinc, ferric chloride, and the chlorides of barium, strontium, and lime. The watery solution has an acid reaction, and when treated with nitric acid yields mucic and oxalic acids. The pulp exhausted by petroleum ether affords a light yellow extract, which contains traces of resin, is insoluble in water, and is not coloured by ferric chloride; chloroform removes from it a similar extract, but of a greenish colour, owing to the presence of a trace of chlorophyll. The alcoholic extract is of a reddish-brown colour and partly soluble in water; the insoluble portion re-dissolved in alcohol is coloured bluish-green by ferric chloride; the soluble portion is coloured red by the same reagent, and reduces freely Fehling's solution. According to Heckel and Schlagdenhauffen, the following is the composition of the pulp:—

Principles soluble in petroleum ether and chloroform	0·0530		
Principles soluble in alcohol	9·9783	2·4370	phlobaphenes
		5·5753	glucose
		1·9660	tartaric acid and traces of alkaline acetate
Principles soluble in water	54·2840	8·8397	glucose
		33·6623	mucilage and gum
		11·7820	bitartrate of potash
Ash by difference	35·6847	32·2350	woody and colouring matter
		3·4497	salts
	100·000	100·000	

The pericarp of the fruit according to Heckel and Schlagdenhauffen contains :—

Water	12·176
Alcoholic extract : colouring matters, albuminoids, phlobaphene	3·860
Watery extract : albuminoids, colouring matters, salts, and gummy matters	7·357
Ash : fixed salts, chiefly carbonate of potash and soda	5·278
Woody tissue (by difference)	71·258
	100·000

The leaves examined by the same chemists were found to have the following composition :—

Soluble in petroleum ether ...	Wax	1·450
Soluble in alcohol	Glucose	1·625
	Wax	3·245
	Salts	0·755
	Undetermined matters	2·225
Soluble in water, gummy and albuminous matters		20·31
Ash, chiefly chloride of sodium, and carbonates of potash and soda		4·55
Lignin, by difference		65·84
		100·00

Messrs. Heckel and Schlagdenhauffen found no trace of an alkaloid in the bark, nor of any such substance as saponin, or the adansonin of Wittstein and Walz. Its composition was—

Soluble in petroleum ether ...	Wax	0·425
Soluble in alcohol	Wax	3·0375
	Insoluble tannin	2·2925
	Soluble tannin	0·7825
	Chloride of sodium	0·08
Soluble in water, gummy and albuminous matters		1·35
Ash, chiefly chloride of sodium and carbonates of potash and soda		6·2905
Lignin, by difference		85·742
		100·00

—(*Les Nouveaux Remèdes*, 1888, *pp*. 385, 481.)

PAVONIA ODORATA, *Willd.*

Fig.—*Wall. Cat.* 1886, 1, 2. *D., E.*

Hab.—N.-W. Provinces, Sind, W Peninsula, Burmah, Ceylon.

Vernacular.—Sugandha-bala (*Hind.*), Bala (*Beng.*), Káláválá (*Mar.*), Perámúttiver (*Tam.*), Bálarakkasi-gida (*Can.*).

History, Uses, &c.—This plant is called Bala and Hrivera in Sanskrit. The root is used in Hindu medicine to prepare a fever drink known as *Shadanga paniya*, which is made by boiling one drachm each of the roots of *Andropogon muricatus* and *Cyperus rotundus* or *pertenuis*, Red Sandalwood, the herb of *Oldenlandia herbacea*, the roots of *Pavonia odorata*, and dry ginger, in two sérs of water down to one sér. It is considered to be cooling and stomachic. The genus Pavonia is named after Don Josef Pavon, a botanical traveller in Peru. Ainslie (*Mat. Med. ii*, 297,) notices the use of *P. odorata* by the Hindus, but expresses no opinion as to its medicinal properties. In Bombay, Serpentary root imported from Europe, is universally substituted for this drug. In *P. odorata*, as in the Musk Mallow, the mucilaginous properties of the genus are combined with an odorous matter having the stimulating and carminative action of musk.

Description.—Roots 7 to 8 inches long, more or less twisted, not more than ¼ inch in diameter at the thickest part; giving off numerous thin fibres and having a delicate musky odour. Bark light brown, nearly smooth, wood hard, yellowish. The plant has the musky odour of the roots; it is herbaceous, erect, and covered with sticky hairs. Flowers pink; carpels obovoid, size of a small pea; seeds brown, oily, not musky.

GOSSYPIUM STOCKSII, *Mast.*, var. herbaceum, *Linn.*

Fig.—*Wight Ic.*, *t.* 9, 11; *Royle Ill.*, *t.* 23. Cotton plant (*Eng.*). Cotonnier (*Fr.*).

Hab.—Sindh. Cultivated in most hot countries.

Vernacular.—Kapás (*Hind.*, *Mar.*), Vona (*Guz.*), Paruthi (*Tam.*), Hatti-gida (*Can.*), Karpás (*Beng.*), Patti-chettu, Kárpásamu (*Tel.*).

History, Uses, &c.—Cotton, the Karpási of Sanskrit writers, was doubtless first known and made use of by the Hindus; it is the *βυσσος* of the later Greek writers, such as Philostratus* and Pausanias,† but not of the earlier Greeks, who applied this term to a fine kind of flax used for making mummy cloths. Theophrastus‡ calls it Eriophora, Pliny Gossympinus, Gossypion, and Xylinum.§ In Arabic cotton is called قطن and كرفس (Kuttun and Kurfus), the latter term being evidently derived from the Sanskrit. Eastern physicians consider all parts of the cotton plant to be hot and moist; a syrup of the flowers is prescribed in hypochondriasis on account of its stimulating and exhilarant effect; a poultice of them is applied to burns and scalds. Cotton cloth or mixed fabrics of cotton with wool or silk are recommended as the most healthy for wear. Burnt cotton is applied to sores and wounds to promote healthy granulation; dropsical or paralysed limbs are wrapped in cotton after the application of a ginger or zedoary *lep* (plaster); pounded cotton seed, mixed with ginger and water, is applied in orchitis. Cotton is also used as a moxa, and the seeds as a laxative, expectorant, and aphrodisiac. The juice of the leaves is considered a good remedy in dysentery, and the leaves with oil are applied as a plaster to gouty joints; a hip bath of the young leaves and roots is recommended in uterine colic. In the Concan the root of the *Deokapás* (fairy or sacred cotton bush) rubbed to a paste with the juice of patchouli leaves, has a reputation as a promoter of granulation in wounds, and the juice of the leaves made into a paste with the seeds of *Vernonia anthelmintica* is applied to eruptions of the skin following fever. In Pudukota the leaves ground and mixed with milk are given for strangury.

Cotton root bark is official in the United States Pharmacopœia, also a fluid extract of the bark; it appears to have first attracted

* 71. † VI., 26. ‡ H. P. IV., 9. § 19, 2.

attention from being used by the female negroes to produce abortion. There appears to be little doubt that it acts like ergot upon the uterus, and is useful in dysmenorrhœa and suppression of the menses when produced by cold; a decoction of 4 ounces of the bark in two pints of water boiled down to one pint may be used in doses of two ounces every 20 or 30 minutes, or the fluid extract may be prescribed in doses of from 30 to 60 minims. Cotton seed tea is given in dysentery in America; the seeds are also reputed to be galactagogue.' (*Stillé and Maisch., Nat. Disp., p. 678.*) By treating cotton first with a dilute alkali, then with a 5 per cent. solution of chloride of lime, and lastly with water acidulated with hydrochloric acid, and afterwards well washing it with water, it loses its greasiness and becomes absorbent and a valuable dressing for wounds; this absorbent cotton may be medicated by sprinkling it with solutions of carbolic acid, salicylic acid, boracic acid, &c. Pyroxylin or Gun Cotton is made by dipping cotton into a mixture of equal parts of nitric and sulphuric acids, washing freely with water, and drying.

Description.—Cotton root bark is in bands or quilled pieces, one half a line thick, covered with a brownish-yellow, satiny, very thin cork, by the abrasion of which irregular, dull, brownish orange patches appear. The cork forms slight longitudinal ridges, which are often confluent into elongated meshes, and marked with black circular dots or short transverse lines. The inner surface is whitish or reddish white, of a nearly silky lustre, and finely striate in a longitudinal direction by the thin medullary rays. The bast fibres are long and tough, arranged in tangential rows, and are separated without difficulty in very thin layers. The bark breaks with difficulty in a transverse direction, but is readily torn longitudinally. It is without odour and without taste, with the exception of a very slight acridity and faint astringency. (*Stillé and Maisch.*)

Chemical composition.—The bark contains *starch*, and when fresh, according to W. A. Taylor (1876), a *chromogen*, which dissolves in alcohol with a pale yellow colour, gradually chang-

ing to a bright brownish-red. The same change takes place on keeping the bark for some time, when it yields a red tincture with alcohol. This substance was examined by Prof. Wayne (1872) and W. C. Staehle (1878), who regard it as of a resinous nature. The latter obtained about 8 per cent. of this substance, which is soluble in 14 parts of alcohol, 15 of chloroform, 23 of ether, and 122 of benzol; also in alkalies, from which solutions it is again precipitated by acid. The potassa solution diluted with water is of a sage green tint. Glucose was likewise observed, and the aqueous solution of the alcoholic extract contained a principle which gave a purplish-black precipitate with ferric chloride. C. C. Drueding (1877) obtained also a yellow resin soluble in petroleum-benzine, a fixed oil, a little tannin and 6 per cent. of ash. (*Stillé and Maisch.*) Cotton seeds are small in size, and vary from ellipsoid to fusiform, and in colour from pale grey through yellow and brown to almost black. Of forty samples examined the amount of oil varied between 10 per cent. in an immature and badly dried Sea Island seed, to 29 per cent. in fully matured Egyptian seed. The albuminoids and other nitrogenous substances varied from 18 to 25 per cent., and the lignin from 15 to 25 per cent. One hundred pounds of seed give on an average—

Hulls with lint	49—46	pounds.
Cake	38—37	,,
Oil	16—14	,,

The crude oil has 28 to 30 times the viscosity of water. At 20° C. it has a specific gravity of ·9283 and at 15° C. of ·9306. It congeals at —1°·9 C. to —2°·7 C. In taste and odour it resembles linseed oil, and in other properties it is intermediate between a drying and a non-drying oil. The refined oil has a specific gravity of ·9264 at 15° C. and congeals at 0° C. to —1·2 C. Chemically cotton seed oil consist of palmatin and olein, and its ultimate percentage composition is carbon 76·40, Hydrogen 11·40, Oxygen 12·20. (*Brannt.*) Cotton seed oil is not suitable for pharmaceutical purposes.

Commerce.—Cotton root bark is not an article of commerce in India; it may be obtained fresh in most parts of the country. Cotton seed oil is largely manufactured in the United States; in 1888 the Atalanta mills pressed 15,000 tons of seed, obtaining 4,668,750 pounds of oil, worth 30 cents a gallon, or 7½ lbs.

The meal obtained was 10,331,250 lbs. and 300,000 lbs. of lint cotton were removed from the seeds before expressing the oil. The lint was worth 18,000 dollars, and the meal which is used as a manure 88,603,58 dollars.

The following plants belonging to the Malvaceæ are also used medicinally on account of their mucilaginous properties :—

Hibiscus tiliaceus, *Linn.*, **Malva parvifloræ,** *Linn.*, **Malachra capitata.** *Linn.*, **Urena lobata,** *Linn.*, and **Kydia calycina,** *Roxb.* The bark of the last named plant is used in sugar refinery. It is a remarkable bark abounding in gum; the gum comes from the liber, where the layers may be separated like pieces of lace; on scraping away the outer layer, the gum is seen protruding between the longitudinally disposed fibres. In the *Pharmacographia* it is stated that Althæa gum occurs in cells; in this bark it appears to be formed from cellulose, as the cells seem to be disrupted and the cell walls absorbed.

STERCULIACEÆ.

STERCULIA URENS, *Roxb.*

Fig.—*Roxb. Cor. Pl. I. 25, t. 24.*

Hab.—Throughout India, Ceylon. The gum.

Vernacular.—Bali, Gúlú, Kúlú, Karai, Kalru (*Hind.*), Karai (*Guz.*), Pándrúk, Kávali, Kandúl (*Mar.*), Penári (*Can.*), Kávali, Tabsu (*Tel.*), Vellay-putali (*Tam.*).

History, Uses. &c.—It is uncertain whether this tree is mentioned by Sanskrit writers, as it appears to have been

confounded with *Cochlospermum Gossypium*, which yields a similar gum. Possibly it may be the tree spoken of as Balika. The gum is collected for sale in most parts of India, and is largely used for making native sweetmeats, and as a substitute for tragacanth. The seeds yield an oil containing much stearin (*Hawkes*), and are eaten by the Ghonds and Kukus in the Central Provinces. (*Brandis.*)

It has been shown by Van Tieghem that "in the Sterculiaceæ the gum is produced in large secretory cells formed by the separation of contiguous cells. These cells surrounding the canals are surrounded by smaller cells, which become dissociated as the canal enlarges, and so altered in appearance as to be scarcely recognizable. In *Cola acuminata* the gum canals are present in the pith and bark." (*Bull. Soc. Botanique de France*, p. 11, and *Pharm. Journ.* (3), xv., 893.)

Description.—On cutting off a young branch of *Sterculia urens* the gum is seen exuding as a soft solid mass from very large canals in the pith and bark, and it appears to be contained in the tissues with some tension as the gum is extruded in a short time to the extent of about half an inch. The very young portions of the trees, as the branches of the panicled inflorescence and the petioles of the leaves also extrude the gum. The gum is completely soluble in cold water, forming an almost colourless solution. Seen in volume it is slightly opalescent. Thirty grains dissolved in twenty ounces of water forms a thick, tasteless, mucilage, which entirely passes through a paper filter. A solution of this strength, examined in a column 200 m.m. long, was optically inactive, neutral to litmus, and not precipitated by alcohol. A very thick mucilage is, however, precipitated. It is gelatinized by basic acetate, and gives a faint precipitate with neutral acetate of lead, but is unaffected by ferric chloride or borax and not coloured blue by iodine. It is precipitated by boiling with an alkaline solution of cupric tartrate, but the copper is not reduced. The gum treated with nitric acid yields abundant crystals of mucic acid. It loses 16 per cent. of water by

drying at 100° C., and on incineration yields about 4 per cent. of ash. Examined under the microscope, no starch can be detected, but a few small polygonal parenchyme cells are usually to be met with. The mucilage possesses little or no adhesive power.

From some comparative experiments made with cod-liver and castor oils it appears to be about equal to tragacanth as an emulsifying agent. (*J. G. Prebble.*)

Commerce.—The gum exudes most abundantly in the cold weather, and is collected by the forest tribes. Value about Rs. 12 per cwt.

In China the fruits of **Sterculia scaphigera,** *Wall.*, are used on account of the large quantity of gum, which they contain under the name of *Ta-hai-tszĕ*. They were introduced into France as a cure for dysentery under the name of *Boa-tam-paijang*, but were found to act simply as a demulcent. Those fruits are from ¾ to 1½ in. long, ovoid, usually somewhat elongated at the lower extremity, which terminates by a large oblique cicatrix. Externally they are of a dark-brown, deeply wrinkled, though generally less so at the superior extremity. The pericarp, which is from $\frac{1}{10}$ to $\frac{1}{20}$ of an inch in thickness, consists of a thin epidermis, beneath which lies a dry, black, resinous-looking pulp, surrounding a fragile shell lined with a whitish membrane. The central portion of the fruit is occupied by two cotyledons, which in their dried state are thin and concave. When the fruit is macerated in water, its outer shell, or pericarp, increases enormously in volume, forming a large gelatinous mass. (*See Hanbury's Science Papers, p. 235, where a figure of the fruit will be found.*) Guibourt found in the pericarp, green oil 1·06, bassorin 59·04, brown astringent matter and mucilage 1·60, woody fibre and epidermis 3·20; and in the nucleus, fatty matter 2·98, saline and bitter extractive 0·21, starch and cellular tissue 31·91 per cent.

Several species of sterculia afford large oily seeds, which are eaten by the natives. Of these, *S. fœtida, Linn.*; *Wight Ic.*,

t. t. 181, 364, may be taken as a type. It is a large tree of the Western Peninsula, Concan, Malabar, Burma, and Ceylon, and is often called "wild almond" in the vernaculars. The Tamils also call it Kudrap dukku, from the resemblance of its large follicle to the testicles of a horse. The seeds are elliptic, about an inch long, and half an inch in diameter, covered with a loose black parchment, and having a yellow caruncle at the base. A white felt-like layer covers the hard black shell, which is brown and velvety within, and encloses an oily white kernel of the same shape as the seed. Each seed weighs about two grains. The shells are difficult to powder. The felt-like skin softens in water like bassorin. The kernels contain about 10 per cent. of fixed oil and a large quantity of starch.

Loureiro states that the bark of this tree is aperient, diaphoretic, and diuretic, and is given in dropsy and rheumatism by the Chinese. The flowers are remarkable for their stercoraceous odour.

The fixed oil of *Sterculia fœtida* is thick, pale yellow, bland, and non-drying. It commences to deposit crystalline solid fats at 18° C., and the whole congeals at about 8°. The specific gravity at 15·5° is ·9277; Saponification equivalent 266·2. The crystalline fatty acids melt at 29° to 30°. With sulphuric acid it forms a thick orange-red mixture. With cold nitric acid it becomes opaque and slightly deepens in colour; when heated with the acid, it changes to a deep coffee-brown. The portion of the lead soap of the fatty acids, insoluble in ether, amounted to 68·9 per cent., and the liberated acid without any purification had a melting point approximating that of stearic acid. The fatty acids from the lead soap, soluble in ether, consisted of oleic with a small quantity of lauric acid.

HELICTERES ISORA, *Linn.*

Fig.—*Wight Ic.*, *t.* 180; *Rheede Hort. Mal.* 30.
East Indian Screw tree (*Eng.*).

Hab.—Central and Western India and Western Peninsula, Ceylon. The fruit and root.

Vernacular.—Marori, Marorphali (*Hind.*), Mriga-shinga (*Guz.*), Kevani, Varkáti, Dhámani (*Mar.*), Valumbirikai (*Tam.*), Atmorha (*Beng.*).

History, Uses, &c.—This is a tall shrub, or small tree, much resembling the common hazel; the flowers, which are bright red and showy, appear in the rains. In Sanskrit it is called Avartani and Mriga-shinga or "deer's horn." The peculiar twisted form of the carpels has probably led to its use as a medicine according to the ancient doctrine of signatures. Ainslie notices its use by the Hindus as a remedy for offensive sores inside the ears. At the present time it enters into most prescriptions for the cure of griping in the bowels, and flatulence, especially in the case of children. Its chief virtue seems to be its harmlessness. It is indispensable at the marriage ceremonies of the Vaisya caste, being tied upon the wrist of bride and bridegroom along with the fruit of *Randia dumetorum*. Persian names for it are Kisht-bar-kisht and Pechak. It is the Kisht-bar-kisht of Ibn Sina, who describes it as hot and dry in the third degree. In the Concan the root-bark is prescribed in diabetes. We have been unable to discover that this plant has any properties beyond those of a demulcent and mild astringent. The roots may be used as a substitute for althæa.

Description.—The fruit consists of five slender angular carpels, twisted like a corkscrew, and together forming a cone about 1½ to 2 inches long. The carpels are pubescent, and of a greenish brown colour; they contain a single row of dark brown angular seeds. The internal surface is of a light greenish hue and highly polished; taste mucilaginous. The root bark is of a dark-brown colour, and is very thickly studded with small round warts so as to present almost the appearance of Shagreen.

Commerce.—The fruit is kept in all druggists' shops, and as a domestic remedy is perhaps one of the best known articles in

the Hindu Materia Medica. Value, Rs. 3½ per Surat maund of 37½ lbs.

Pterospermum suberifolium, *Lam. Ill., t.* 576, *f.* II., Muchkand (*Hind.*), bears white fragrant flowers, which rubbed into a paste with kángika (rice vinegar) are an ancient and well known Hindu remedy for hemicrania. The Sanskrit name of the plant is Muchukunda, which appears to be derived from मुच्, Greek μυσσω, Latin mungo, whence mucus, and कुन्द a sweet-smelling flower. The flowers render water gelatinous.

P. acerifolium, another species, is called in Sanskrit Karnikára, in Hindi Kaniár and Katha-champa, and in Bengali Kanakchampa. In Sikkim it is known as Hathipaila, and the hill people use the white tomentum from the under surface of the leaf to stop bleeding. In the Concan the flowers and bark of these trees are charred and mixed with Kamala, and applied in suppurating small-pox. Karnikára is mentioned by Kálidása as "a flame of the woods." The tree he alludes to is evidently *Cassia Fistula*, which also bears this name in Sanskrit.

ABROMA AUGUSTA, *Lam.*

Fig.—*Lam. Ill., t.* 636 *and* 637. Devil's Cotton (*Eng.*).

Hab.—India and the East. Native or cultivated. The root.

Vernacular.—Ulat-kambal (*Beng.*), Olak-tambol (*Bomb.*).

History, Uses, &c.—This shrub has long been known as a plant yielding a valuable fibre (*Royle's Fibrous Plants of India*, *p.* 267). In 1872, Mr. Bhoobun Mohun Sircar (*Ind. Med. Gaz.*) first called attention to the use of the root as an emmenagogue in Bengal, and recommended the fresh viscid sap in the treatment of dysmenorrhœa in doses of 30 grains. Subsequently Dr. Kirton recommended the use of drachm doses of the root

beat into a paste with water. Dr. Watt in his "Dictionary of the Economic Products of India" records the opinion of thirteen medical men regarding the medicinal properties of the plant; of these, eight speak favourably of it. Dr. R. Macleod says:—"It is a valuable medicine in dysmenorrhœa, the fresh root is usually given, made into a paste with black pepper about a week before the time of menstruation, and is continued until it commences. I have seen it prove very efficacious in some cases, especially in the congestive form of the disease." Dr. Thornton says:—"The slender roots are useful in the congestive and neuralgic varieties of dysmenorrhœa. It regulates the menstrual flow and acts as a uterine tonic. It should be given during menstruation, 1½ drachms of the fresh root for a dose with black pepper, the latter acting as a stomachic and carminative." Dr. Evers says:—"It has never failed in my hands in speedily relieving painful dysmenorrhœa." In Western and Southern India the plant is not common, and its medicinal properties do not appear to be known.

Description.—A small tree or shrub, with soft velvety branches, and ovate-oblong, serrulate leaves, the under surface of which is tomentose. The flowers are dark purple and drooping, and have five petals with dilated claws. The fruit is a dry, 5-celled capsule, with 5 truncated wings. When ripe it dehisces at the apex, exposing the five inner angles of the cells crested with stiff silky hairs which penetrate and irritate the skin if handled. Each cell contains numerous black seeds the size of radish seeds. The roots have a thick, fibrous, brown bark, which, when freshly cut, protrudes a thick gummy substance like others of the genus. (*See Sterculia urens.*)

Chemical composition.—The bark was separated from the dried roots and reduced to powder. Dried at 100° C: the powder lost 5·37 per cent. of moisture. The ash calculated on the undried powder amounted to 11·64 per cent. There was nothing special to note regarding the composition of the ash; it did not contain manganese.

Treated with light petroleum ether 0·4 per cent. of a yellow soft extract was obtained, which was odourless and tasteless. In cold alcohol it was partly soluble, the solution possessing an acid reaction, and leaving on spontaneous evaporation an indistinctly crystalline residue. The portion insoluble in cold alcohol was white and had the physical properties of a wax.

After the action of petroleum ether, the powder was dried and exhausted with ether, which yielded on evaporation ·88 per cent. of yellow odourless non-crystalline extractive. This extract was insoluble in water and in dilute acids. In alcohol it was partially soluble with acid reaction. In alcoholic ammonia the extract was almost wholly soluble, the solution being of a yellow colour: the addition of acids to the ammoniacal solution caused the separation of whitish flocks. The ether extract gave no reaction with iron salts.

After removal of ether from the powder, it was treated with absolute alcohol, and on evaporating off the spirit 1 per cent. of a yellow non-crystalline extract was left. This extract was slightly soluble in water, with acid reaction; by the action of dilute sulphuric acid, a yellowish solution was obtained, and a yellow insoluble residue left. The acid solution did not give any reaction with alkaloidal reagents. The residue insoluble in dilute acid was wholly soluble in aqueous ammonia, the resulting solution being of a deep yellow colour: the addition of acids caused the precipitation of yellowish white flocks which were easily soluble in chloroform. A portion of the original alcoholic extract gave no reaction with iron salts. The powder after exhaustion with alcohol was dried. When treated with water the dry powder formed a viscid mass; by the action of boiling water the mucilage partly dissolved, the solution did not gelatinize on cooling. A trace of starch was present.

PENTAPETES PHŒNICEA, *Linn.*

Fig.—*Rheede, Hort. Mal. x.*, t. 56; *Cav. Diss.* iii., t. 43, *f.* 1.

Hab.—Throughout the hotter parts of India.

Vernacular.—Dopahariya (*Hind.*), Kát-lálá, Bándhuli (*Beng.*), Tambri-dupári (*Mar.*), Nága-pú (*Tam.*)

A large annual (4 to 5 ft.) found in rice-fields and other wet places during the monsoon. It is the Naga-pu of Rheede. The capsules of this plant are used medicinally on account of their mucilaginous properties; they are subglobose, bristly, 5-celled, 5-valved, about half the length of the persistent interior calyx, which is 5-partite and bristly. Each cell contains from 8 to 12 seeds arranged in two vertical rows. (*See Gartn. Fr., t.* 134.) The plant appears to have attracted the attention of the Hindus on account of its peculiar habit and time of flowering, and has many Sanskrit names, such as Bandhuka and Bandhujiva, living in association or groups; Arka-vallabha, beloved of the sun; Pushparakta, red-flowered, &c.

TILIACEÆ.

CORCHORUS TRILOCULARIS, *Linn.*

Fig.—*Jacq. Vind.* 2, *t.* 173. Trilocular Jew's Mallow (*Eng.*), Corete triloculaire (*Fr.*).

Hab.—Asia, Africa. The seeds.

Vernacular.—Kurrú Chuntz (*Mar.*), Pát (*Hind., Beng.*), Peratti-kirai (*Tam.*), Parinta (*Tel.*). The seeds, Raja-jíra (*Guz.*).

History, Uses, &c.—*C. trilocularis* is a small annual plant which appears in the rainy season along with *C. olitorius*, from which it may be distinguished by its oblong, lanceolate leaves, trilocular capsules, and small seeds; both plants are known by the name Nádika in Sanskrit. Ainslie mentions the latter plant as being used medicinally by the Hindus, and says that they reduce it to ashes and mix it with honey for administration in obstructions of the abdominal viscera. He also notices its use as a pot-herb. According to Twining, an infusion of the leaves forms a useful fever drink. In India

the seeds of *C. trilocularis*, which are bitter, are administered in doses of about 80 grains in fever and obstructions of the abdominal viscera. A bitter corchorus was known to the Greeks. Theophrastus says ὁ παροιμιαζόμενος διὰ τὴν πικρότητα κόρχορος. (H. P., VII. 7.) Pliny (21, 106) also mentions Corchorus as a poor kind of pulse growing wild.

Description.—The seeds, which are closely packed in the trilocular capsule, are small, black and angular; they are generally more or less mixed with those of *C. olitorius*, which may easily be distinguished by their greater size ($\frac{1}{10}$th of an inch) and peculiar shape, which resembles that of a mooring buoy.

Corchorus fascicularis, *Lam.*, a native of tropical India, Australia and Africa, is a small procumbent woody plant with oblong or lanceolate serrated leaves; peduncles 2—5 flowered, opposite to the leaves; capsules linear oblong, nearly terete, rostrate, three-celled, about half an inch long, clothed with simple hairs; they contained a number of small dark-brown angular seeds. The whole plant is sold in the shops; it is very mucilaginous and somewhat astringent, and is valued as a restorative. Hirankhorí is the name given to it by the country people, and means deer's hoof. In the Calcutta and Bombay shops it is called Bhaphalí, which name must not be confounded with Bhaphalí, the Marathi name for *Peucedanum grande*, an umbelliferous plant.

C. fascicularis has been received from Poona under the name of *Magarmithi*. *C. Antichorus, Ræusch.*, *Wight Ic.* 1073, is also sold as Baphalí.

GREWIA TILIÆFOLIA, *Vahl.*

Fig.—*Beddome, Fl. Syl., t.* 108.

Hab.—Western India to the Himalayas, Burma, Ceylon.

Vernacular.—Dhámaní (*Hind., Beng.*), Dháman (*Mar.*), Thada, Tharra (*Tam.*), Charachi (*Tel.*), Butale (*Can.*).

History, Uses, &c.—A tree, leaves hoary beneath, oblique cordate, dentate, 5-nerved, feather veined, petioles 1 inch, pubescent, thickened at the top, stipules leafy, falcate acuminate, auricled on one side, flowers yellow. The berries have an agreeable acid flavour and are eaten. Bark thick, white internally, covered externally by a thin grey suber which readily peels off, showing a slightly rough, green surface beneath, very mucilaginous and sweetish to the taste. In the Concan the bark, after removal of the suber, is rubbed down with water and the thick mucilage strained from it and given in 5 tolá doses with 2 tolás of the flour of *Panicum miliaceum*, as a remedy for dysentery. The Sanskrit name of the tree is Dharmana, and this name is loosely applied to several species of Grewia.

The bark of **G. asiatica**, *Linn*, has similar properties. The tree is called Parusha in Sanskrit, Phalsa in Hindi, Shukri in Bengali, Phalshi in Marathi, and Putiki in Telugu. It is cultivated for its acid fruit, which is one of the *phala-traya* or fruit triad of Sanskrit writers. (See *Pomegranate*.)

Grewia scabrophylla, *Roxb.*, with scabrous leaves, stem and fruit, Khatkhati (*Mar.*), is given in accordance with the doctrine of signatures as a remedy for leprosy in the Concan; it appears to be simply mucilaginous like most of the genus. Its roots are the althéa of the Portuguese in Goa, and are used as a substitute for Althæa.

Triumfetta.—The plants belonging to this genus are mucilaginous, and are used as demulcents.

The burr-like fruit is said to promote parturition. **T. rhomboidea**, *Jacq.*, often confounded with *Sida* (see *Malvaceæ*) by the natives, is generally used. The plants of this genus are the Lappuliers of the French colonies, and bear the significant names of *Herbe à cousin*, *pou de moine*, and *tête à nègre*.

LINEÆ.

LINUM USITATISSIMUM, *Linn.*

Fig.—*Bentl. and Trim.*, t. 39. Common Flax (*Eng.*), Lin usuel (*Fr.*).

Hab.—Egypt. Cultivated in India. The seeds and oil.

Vernacular.—Alsí, Tísí (*Hind.*), Alishi-virai (*Tam.*), Mosiná (*Beng.*), Alashi, Javas (*Mar.*), Atasi, Madana-gingelu (*Tel.*), Alashi (*Can.*).

History, Uses, &c.—Linseed, called in Sanskrit Atasi, appears to have been but little used as a medicine by the Hindus. The Mahometans have paid more attention to the plant; they consider it to be cold and dry, and that clothes made with the fibre cool the body and lessen perspiration; they recommend fumigation with the smoke for colds in the head and hysteria, and use the tinder to staunch hæmorrhages. Sherriff says if you wish to become thin wear washed linen clothes in the summer but not in winter. The flowers are said to be cardiacal, the seeds aphrodisiacal, and hot and dry. Linseed poultice is recommended for gouty and rheumatic swellings; as an emollient the mucilage is dropped into the eye; with honey it is prescribed in coughs and colds. The roasted seeds are said to be astringent. In Western India, the unripe fruit is used as a vegetable. Flückiger and Hanbury in their *Pharmacographia* (p. 89) give a summary of the history of the plant in the West, and trace its use back to the 23rd century, B. C. It is the λίνον of Dioscorides and the Linum of Pliny.* Gallesky (1767) strongly advocated the use of Linseed oil in painter's colic and other spasmodic affections of the bowels. In modern medicine Linseed tea is much used as a demulcent drink in cough depending upon an

* Dios. ii. 94. Plin. 19; 1. 20; 92

irritated and inflamed condition of the pharynx and upper part of the respiratory passages. It is also useful in irritation of the intestinal canal and urinary passages. The meal is one of our best poultice materials. The oil with an equal part of lime water forms the well known application for burns and scalds called Carron oil, and is also given internally as an aperient in piles, dose two ounces, morning and evening. Formerly the oil boiled to the consistence of caoutchouc was used for the manufacture of bougies, catheters, and elastic probes. By interrupting the burning linseed oil by covering the boiler, there remains a brown turpentine-like substance, the so-called *birdlime*. (*Braunt.*)

Description.—The capsule, which is globose, splits into 5 carpels, each containing two seeds separated by a partition. The seeds are of a flattened elongated ovoid form, with an acute edge, and a slightly oblique point blunt at one end. They have a brown glossy polished surface, which under a lens is seen to be marked with extremely fine pits. The hilum occupies a slight hollow in the edge just below the apex. The testa encloses a thin layer of albumen surrounding a pair of large cotyledons having at their pointed extremity a strait embryo. The seeds of different countries vary from $\frac{1}{4}$—$\frac{1}{8}$ of an inch in length, those produced in warm regions being the largest. In India a white variety is sometimes met with. When immersed in water, the seeds become surrounded by a thin, slippery, colourless mucous envelope, which quickly dissolves as a neutral jelly, while the seed slightly swells and loses its polish. (*Pharmacographia*, p 90.)

Chemical composition.—The following summary is extracted from the *Pharmacographia*:—"The constituent of chief importance is the fixed oil which the seed contains to about $\frac{1}{3}$rd of its weight. The proportion obtained by pressure on a large scale is 20—30 per cent. The oil when pressed without heat and when fresh has but little colour, is without unpleasant taste and does not solidify till cooled to —20°.C. The commercial oil is dark yellow, and has a sharp repulsive taste and

odour. On exposure to the air, especially after having been heated with oxide of lead, it quickly dries up to a transparent varnish, consisting chiefly of linoxyn, C^{32} H^{54} O^{11}. The crude oil increases in weight 11—12 per cent., although at the same time its glycerine is destroyed by oxidation.

"By saponification, Linseed oil yields glycerin, and 95 per cent. of fatty acids, consisting chiefly of linoleic acid, C^{16} H^{26} O^{2}, accompanied by some oleic, palmitic and myristic acid. The action of the air transforms linoleic acid into the resinoid oxylinoleic acid, C^{16} H^{26} O^{5}. Linoleic acid appears to be contained in all drying oils; notably in that of poppy seed. It is not homologous either with ordinary fatty acids, or with the oleic acid of oil of almonds, C^{18} H^{34} O^{2}.

"The viscid mucilage of Linseed cannot be filtered till it has been boiled. It contains in the dry state more than 10 per cent. of mineral substances, when freed from which and dried at 110° C., it corresponds, like althæa mucilage, to the formula C^{12} H^{20} O^{10}. The seeds by exhaustion with cold or warm water afford of it about 15 per cent. By boiling nitric acid it yields crystals of mucic acid. Its chemical relations are therefore those of gum and not of soluble cellulose. Linseed contains about 4 per cent. of nitrogen, corresponding to about 25 per cent. of protein substances; after expression of the oil, these substances remain in the cake.

"In the ripe state, Linseed is altogether destitute of starch, though this substance is found in the immature seed in the very cells which subsequently yield the mucilage. The water retained by the air-dry seed is about 9 per cent. The mineral constituents of Linseed, chiefly phosphates of potassium, magnesium, and calcium, amount on an average to 3 per cent. and pass into the mucilage. By treating thin slices of the testa and its adhering inner membrane with ferrous sulphate, it is seen that this tegument contains a small quantity of tannin." A. Jorissen has pointed out that a mixture of linseed meal and warm water, when kept at a temperature of 25° C., and then distilled, yields a distillate containing

containing hydrocyanic acid. (*Bull. Acad. Roy. Belg.* (3) V., 750.) The oil is obtained by three methods, cold drawn, by the aid of heat and expression, and by the use of solvents. Seeds 2 to 6 months old are generally used, as the oil from fresh seeds is viscous and turbid. (*Brannt.*) Four qualities of oil are produced, raw, refined, boiled, and artist's oil.

Commerce.—In 1872, India exported to the United Kingdom £1,144,942 worth of Linseed. In 1882 the total exports were valued at more than £3,000,000, and in 1885-86, and 87, the average value of the exports was nearly £5,000,000.

ERYTHROXYLON MONOGYNUM, *Roxb.*

Fig.—*Cor. Pl. i. t.* 88; *Wight Ill. t.* 48.

Hab.—Hilly parts of the Western Peninsula, Ceylon. Red Cedar, Bastard Sandal (*Eng.*).

Vernacular.—Tevadarum, Devadarum (*Tam.*), Adavi-goranti (*Can.*).

E. monogynum is a shrub with pale bark and cuneate obovate leaves, the primary nerves of which are hardly distinguishable from the secondary, which latter are not connected with the intra-marginal nerve. The leaves of this plant are refrigerant, and were largely eaten during the famine in the Madras Presidency, in 1877, by the natives of several districts where it grew wild in abundance, and it was thought probable that they might be found to contain an alkaloid with properties similar to that which is obtained from *E. Coca.* Dr. Cornish just before he left India wrote to ask Mr. Lawson to have the subject investigated, and several consignments of the leaves from the Cuddapah district, were sent to the Government Quinologist for analysis, who found that they contain no anæsthetic principle at all analagous to Cocaine, but a bitter and tonic alkaloid which may have mitigated the pangs of [illegible]ger. Squibb's method was used in examining these leaves,

and by the same method, no difficulty was found in obtaining Cocaine from *E. Coca* grown in India. The wood is fragrant, whence the name Bastard Cedar, and the bark is used as a tonic in the Madura district.

Hugonia Mystax, *Linn., Rheede Hort. Mal. ii., t.* 19; *Wight Ill. i., t.* 32, is a rambling, leafy, tomentose shrub, with yellow flowers, found in the Western Peninsula from the Concan to Travancore, and in Ceylon. According to Rheede, who calls it *Modera canni,* the bruised roots are used to reduce inflammatory tumours and internally as a febrifuge and anthelmintic.

ZYGOPHYLLEÆ.

TRIBULUS TERRESTRIS, *Linn.*

Fig.—*Wight Ic., t.* 98. Small Caltrops (*Eng.*).

Hab.—India and other warm countries. The fruit and root.

Vernacular.—Chota Gokhrú (*Hind.*), Gokhuri (*Beng.*), Lahana Gokhru (*Mar.*), Nerunji (*Tam.*), Negalu-gida (*Can.*), Mitha Gokhru, Beththa Gokhru (*Guz.*). Palleru-mullu, Chiru-palleru (*Tel.*).

History, Uses, &c.—This plant is the Gokshura and Ikshugandha of Sanskrit writers; the first of these names signifies "cow's hoof" from the resemblance of the cocci when adhering together in pairs, as is frequently the case, to a cloven hoof, the second alludes to the aroma of the plant. The Hindus use the fruit and root; they regard them as having cooling, diuretic, tonic and aphrodisiac properties, and use them in gonorrhœa and dysuria. The root is one of the ten drugs which go to form the Dasamula Kvatha, a compound decoction often mentioned in Sanskrit works. The ten plants are *Desmodium gangeticum, Uraria lagopodioides, Solanum*

Jacquini, *Solanum indicum*, *Tribulus terrestris*, *Ægle Marmelos*, *Calosanthes indica*, *Gmelina arborea*, *Stereospermum suaveolens*, and *Premna spinosa*. The first five of these are called Hrasva (or laghu) pancha mula, or the five minor plants, and the last five, Vrihat pancha mula, or the five major plants. According to Loureiro, *T. terrestris* is astringent.

It is the Khasak or Hasak of the Arabs and Persians; and is well described by Ainslie, who says:—"It is a common plant near the Dardanelles, and is called in modern Greek τριβόλια. Dioscorides calls it τρίβολος and Pliny tribulus; they both describe two kinds, '*terrestris*' and '*aquaticus*.' The latter is the *Trapa natans*, *Linn.*, or Water Chestnut.* In the Pharmacopœia of India the use of *T. terrestris* as a diuretic in Southern India is noticed." In Pudukota the flowers rubbed with silver are applied in inflammation of the cornea. The action of this drug on the mucous membrane of the urinary passages appears to resemble closely that of Buchu and Uva Ursi; it may often be advantageously combined with opium and hyoscyamus.

Description.—*Tribulus terrestris* has a slender fibrous root, 4 to 5 inches long, cylindrical, and of a light brown colour; the odour is faintly aromatic and the taste sweetish and astringent. From the root spring four to five delicate stalks, spreading flat on the ground; these are hairy and extend to 2½ feet in length; the leaves are pinnated, leaflets 5 to 6 pairs, nearly round. The flowers are axillary on short peduncles, and composed of five broad obtuse yellow petals; these are succeeded by a roundish five-cornered fruit, about the size of a marble, armed with prickles; this ripening divides into five cells, each armed with 4 strong sharp thorns

* Dios. iv., 16. Plin. 21, 58; 22, 12. Professor Flückiger has drawn attention to the abundance of manganese in this plant, a fact which has been demonstrated by Gorup-Besanez. *Trapa bicornis* of China and *Trapa bispinosa* of India (Singhára) resemble it in this respect; they are largely used as articles of food in the East, and considered cooling in bilious affections with diarrhœa.

and containing several seeds. The cocci are wedge-shaped, yellowish when ripe, the external convex surface being rough between the thorns. When all five are *in situ*, the fruit presents ten thorns pointing towards the peduncle, and ten pointing outwards round the circumference; the latter are developed first. This may account for the statement in some books that each coccus has only two spines. The seeds are oily, and enclosed in very hard stony cells. The taste is faintly aromatic and rather agreeable.

Chemical composition.—An ethereal or an alcoholic extract of the powdered fruits yields to water a crystalline residue containing a body precipitated from its solutions by ammonia and having the properties of an alkaloid, and associated with hydrochloric acid or alkaline chlorides. The fruits also contain a fat and a resin, the latter probably is the source of the aroma of the drug, as it gives off a fragrant odour when burnt. The fruits contain a rather large quantity (14·9 per cent.) of mineral matter.

Commerce—The fruit is collected in the sandy districts of India; it is always obtainable in the drug marts. Value, Rs. 5 per Surat maund of 37½ lbs.

Tribulus Alatus, *Delile. Boiss. Fl. Orient.* I., 902. Winged Caltrops (*Eng.*). *Vernacular.*—Nindotrikund, Latak (*Sind*), Hasak (*Punj.*). The fruits are used for the same purpose as those of *Tribulus terrestris*. The plant is common in Sind, the Punjab, and Beloochistan. Fruit pyramidal, broadly winged; cocci hirsute, two-seeded; spines confluent. (*Murray.*)

FAGONIA ARABICA, *Linn.*

Fig.—*Wight Ill. i., t.* 64.

Hab.—N.-W. India, Sind, Punjab, W. Peninsula, Egypt. The plant.

Vernacular.—Dhamása (*Bomb.*), Ustarkhár (*Hind.*), Dramahui (*Sind.*).

History, Uses, &c.—This plant is common on grain fields in the Punjab and Deccan; it is suffrutescent, much branched, with opposite two-stipuled leaves; the stipules are often thorny; leaflets linear-cuspidate; the wood of the stem is white and very hard, covered with a ragged, light brown bark, which becomes slimy and mucilaginous when moistened; taste mucilaginous. On account of the prickly nature of the plant it is called in Sanskrit Dusparsha, or "painful to the touch." Dhamása has a great reputation as a suppurative in cases of abscess from thorns, &c.; it is also used for cooling the mouth in stomatitis, the juice being boiled with sugar-candy until quite thick, and a small quantity allowed to dissolve in the mouth frequently; the juice is thought to prevent suppuration when applied to open wounds. Fagonia in Sind and Afghanistan is a popular remedy for fever among the Hill people, and Dr. J. L. Stewart states that *F. Bruguieri, DC.*, is used for the same purpose in the Peshawar valley, and is given to children as a prophylactic against small-pox. It is known by the same vernacular names as *F. arabica*.

GERANIACEÆ.

OXALIS CORNICULATA, *Linn.*

Fig.—*Wight Ic.*, *t.* 18; *Fl. Græc.*, *t.* 451. Horned Wood-Sorrell (*Eng.*), Oxalide corniculée (*Fr.*).

Hab.—A weed of cultivation, Asia, Europe, &c. The plant.

Vernacular.—Amrulsák, Chuka-tripati (*Hind.*, *Beng.*), Ambutí, Bhuí-sarpatí (*Bomb.*), Púli-yárai (*Tam.*). Puli-chintaku (*Tel.*), Pullam-purachi-sappu (*Can.*).

History, Uses, &c.—This plant, called in Sanskrit works Amlalonika and Chángerí, is considered by the Hindus to be cooling, refrigerant, and stomachic. The fresh juice is given to relieve intoxication from Datura, and is said to be useful

in dysentery and prolapsus of the rectum. (*Hindu Materia Medica, Dutt.*) Chakradatta gives the following formula for preparing a ghrita with the herb: *Changeri ghrita*—Take of clarified butter 4 seers, curdled milk (dádhi) 16 seers, leaves of *Oxalis corniculata* beaten into a paste 1 seer. Boil together in the usual way, and prepare a ghrita. The fresh herb made into a poultice with hot water is used as a healing application to various eruptions in the Madras Presidency. In the Concan the plant is rubbed down with water, boiled, and the juice of white onions added: this mixture is applied to the head in bilious headache. Mahometan writers briefly notice the plant as being used by the Hindus. Ainslie describes it, and mentions it use as a cooling medicine in doses of two teaspoonfuls twice a day. The plant is a native of Europe, and is called μοσχοφιλο in modern Greek. In Réunion it is considered a laxative, and is called Petit trèfle.

Description.—*O. corniculata* is one of the most troublesome garden weeds in India; the stems are decumbent, rooting; leaves palmately trifoliolate; leaflets obcordate, pubescent; peduncles 2 to 5-flowered; flowers yellow, capsule linear, oblong, many-seeded, densely pubescent; seeds transversely ribbed. All parts of the plant have an acid taste.

Chemical composition.—The different species of Oxalis contain acid potassium oxalate.

Biophytum Sensitivum, *DC. Bol Reg. xxxi., t.* 68, is a native of Tropical India, Asia, Africa and America.

Vernacular.—Làjri (*Mar.*), Zarir (*Guz.*), Lajàlu (*Hind.*).

This plant is used in incantations. Rumphius sub voce Gallinaria says of it—"Ipse enim Acosta narrat et declarat doctum Bracmanem ipsi spopondisse sub conditione magni certaminis, sese per hanc herbulam effecturum ut mulier, quam desideraret, illum sequeretur, ille autem tam honestus erat ut hasce artes Christianis vetitas, nollet addiscere, nec scriptis suis inserere." Rheede says of it, "the seeds are red and

shining, and are powdered and applied to wounds, and with butter to abscesses to promote suppuration, the root in decoction is given in gonorrhœa and lithiasis."

Averrhoa Carambola, *Linn.*, and **A. Bilimbi**, *Linn.*, *Rheede, Hort. Mal.* iii., 43, 44, 45, are cultivated throughout the hotter parts of India, on account of their acid fruits.

Their native country is uncertain, but some suppose them to have been brought from the Moluccas by the Portuguese, who call them Carambola and Bilimbinos. Like some others of the Geraniaceæ, their leaves are sensitive; their fruits are much used by the natives of India as an acid vegetable, and by Europeans as a tart fruit and preserve. They contain much acid potassium oxalate and are used to remove iron moulds. A syrup of the fruit and a conserve of the flowers are used by the natives as a cooling medicine in fever. *A. Carambola* has a yellow angular fruit about the size of a hen's egg; there are two varieties, sweet, and sour. *A. Bilimbi* produces a yellowish-green fruit with five rounded lobes about the size of a gherkin, whence the English name Cucumber-tree.

GERANIUM NEPALENSE, *Sweet.*

Fig.—*Wight Ill.* i., 153, *t.* 59.

Hab.—Temperate Himalaya, Nilgiris, Ceylon.

Vernacular.—Bhánda (*Hind.*).

GERANIUM OCELLATUM, *Camb.*

Fig.—*Royle, Ill.* 149, 150.

Hab.—Sub-tropical Himalaya, Behar, on Parisnath.

Vernacular.—Bhánda (*Hind.*).

GERANIUM WALLICHIANUM, *Sweet.*

Fig.—*Wight Ic.* t. 324.

Hab.—Temperate Himalaya, Kuram Valley, Afghanistan.

Vernacular.—Mámirán (*Afghan.*).

A plant called γεράνιον is mentioned by Dioscorides (iii. 122,) having a fruit like the the head of a crane (γέρανος); it appears to have been used as an astringent in certain affections of the vagina. Pliny (26, 68) mentions three kinds of this plant which have been identified with *Erodium moschatum, Aiton, Geranium molle, Linn.*, and *Geranium tuberosum, Linn.*

Geranium Robertianum, Linn., Herb Robert (*Eng.*), Bec de grue, Robertin (*Fr.*), a native of Europe and of the West temperate Himalaya, was formerly used in Europe as a vulnerary in hæmorrhages, and as an application to tumours and ulcers; internally it was given in gravel, jaundice and ague. It has a strong odour and a bitter, saline and astringent taste. In America *Geranium maculatum, Linn.*, a native of Canada and the United States, is official, and the root is known as *Alum root*; it contains tannic and gallic acids (*Tilden*), to which it owes its medicinal properties. (*Fig.—Bentl. and Trim.* 42.)

The Indian Geraniums used medicinally, the names of which are placed at the head of this article, have the astringent properties common to the genus. The root of *G. nepalense* affords abundance of red colouring matter, and is used for colouring medicinal oils like alkanet (Ratanjot).

Aitchison in his article upon the Kuram Valley Flora observes that the root of *G. Wallichianum* is called Mámirán by the Afghans, and is used as an astringent application to the eyes. (*Journ. Linn. Soc.*, xviii., p. 26.)

The Arabs call the wild Geraniums Ibrat-ur-raai or Shepherd's needle.

RUTACEÆ.

RUTA GRAVEOLENS, *Linn.*, var. *angustifolia.*

Fig.—*Bot. Mag.* 2311. Garden Rue (*Eng.*), Rue des jardins (*Fr.*).

Hab.—Cultivated in the East. The herb.

Vernacular.—Sudáb (*Hind.*, *Mar*, *Guz.*), Arvada (*Tam.*), Sadápa, Arudu (*Tel.*), Nágadali-sappu (*Can*).

History, Uses, &c.—Rue was held in high estimation by the Greeks and Romans. Aristotle in his *History of Animals* (ix. 6) tells us that the weasel before fighting with serpents, rubs itself against this plant. Hippocrates considered it to be resolvent and diuretic, and notices it in his chapter on female diseases. Pliny notices it in several parts of his Natural History, and calls it one of the best medicinal herbs. Celsus says of Rue, "Urinam movet, sensus excitat, purgat, mollit." Apuleius (*De Ver. Herb.*) recommends the following superstitious practise "ad profluvium mulieris"; "Herbam rutam circumscribe auro et argento et ebore, et sublatam eam alligabis infra talum." Macer Floridus states that Mithridates, king of Pontus, used rue as a protection against poison:—

> "Obstat pota mero vel cruda comesta venenis.
> Hoc Metridates rex Ponti sæpe probavit,
> Qui Rutæ foliis, &c."

Johnston, in his *Thaumatographia Naturalis*, writes:—"Ruta libidinem in viris extinguit, auget in feminis." The plant was hung round the neck in the Middle Ages as a charm against vertigo and epilepsy; it was considered emblematic of good luck, and a protection against sorcery, a herb dear to women, &c. (*De Gubernatis.*)

The Hindus received the plant from the West along with the superstitions connected with it; they burn the leaves for the purpose of fumigating young children suffering from catarrh, and use a tincture of them as an external remedy in paralytic affections, and administer them internally in dyspepsia. They consider rue injurious to pregnant women, an opinion expressed by Dioscorides.

The Arabians class rue among their attenuentia, vesicatoria and stimulantia. The author of the Makhzan-el-Adwiya describes three kinds—garden, wild, and mountain rue. He considers it to be hot and dry in the third degree, to increase the mental powers, to act as a tonic and digestive, and to increase the urinary and menstrual excretions. He also states that it acts as an antaphrodisiac and causes abortion

when given to pregnant women. The diseases in which it is recommended are so numerous that we must refer the reader to his article "Sudáb." The old European physicians considered rue to be antispasmodic, stimulant and emmenagogue, and prescribed it in hysteria and flatulent colic. Boerhaave extols its virtues in promoting perspiration.

Rue is the *Herb Grace* of old English writers, and is still much used as a domestic remedy. Aibert says of it, "Cette plante a une grande action sur le système nerveux, et particulièrement sur le système uterin. Beaucoup de femmes en prennent dans les menstrues laborieuses." The dose of the powdered leaves is from ten grains to a scruple or more, twice or thrice daily. Rue occupies a corner in most Indian gardens. It is largely grown near Grasse in France, 150 to 200 lbs. produce 1 lb. of oil.

Rue is an active irritant, whether applied externally or taken internally. It has been frequently used with success to procure abortion; sometimes it produces painful vomiting, always great prostration, confusion of mind, cloudy vision, feebleness and slowness of pulse, coldness of the extremities, and twitching of the limbs; in pregnant women the drug produces pain in the back, bearing down, and frequent micturition, followed by pains and abortion about ten days after the commencement of its administration. Oil of Rue has been observed to produce similar symptoms with increased frequency and diminished tension of the pulse; on the other hand, when an infusion of the dry leaves was used, the pulse fell from 80 to 69 in three hours.—(*Van de Warker, Criminal Abortion*, 1872.)

Description.—The variety angustifolia is thus described in the *Flora of British India*:—"Leaves petioled, triangular ovate, decompound, segments various, corymbs spreading, bracts lanceolate, sepals triangular acute, petals ciliate, capsule obtuse, shortly pedicelled.

Chemical composition.—The essential oil, when purified by a few rectifications, is somewhat viscid; has a specific gravity of

0·837 at 18°; a strong disagreeable odour, like that of the plant; a slightly bitter aromatic taste; boils at 228°—230°, and solidifies between + 1° and 2°, to shining crystalline laminæ, resembling those obtained from Anise oil. The chief volatile constituents of rue are methyl-nonylketone, and a hydrocarbon. The ketone, separable by alkaline bisulphites, was formerly regarded according to the investigations of Gerhardt and of Cahours, as capric or rutic aldehyde, $C^{10} H^{20} O$. But Greville Williams has shown that the crude oil contains two such compounds, *viz.*, $C^{11} H^{22} O$ and $C^{12} H^{24} O$, the latter in comparatively small quantity; and this result has been confirmed by Harbordt. The portion of rue oil, which does not combine with alkaline bisulphites, is separable into a more volatile portion, having the composition of Turpentine oil, and a less volatile portion, which appears to be isomeric with Borneol, but boils at a lower temperature. For a fuller account of the chemistry of Rue, see *Watt's Dict. of Chem.*, Vol. V., p. 132.

Commerce.—Rue is cultivated in India for medicinal use: It is also imported from Persia. Value, Re. ¼ per lb.

PEGANUM* HARMALA, *Linn.*

Fig.—*Lam. Ill.*, 401. Syrian Rue (*Eng.*), Rue Sauvage (*Fr.*).

Hab.—N.-W. India, Western Deccan. The seeds.

Vernacular.—Hurmal, Hurmaro, Ispand (*Hind.*, *Bomb.*, *Beng.*), Shimai-azha-vanai-virai (*Tam.*), Shima-goranti-vittulu (*Tel.*).

History, Uses, &c.—In native works on Materia Medica, Hurmal is described as an alterative and purifying medicine in atrabilis, and also in diseases supposed to arise from

* πήγανον. The Greeks and Romans speak of two kinds of Peganon or Rue, '*garden*' and '*wild*, or, *mountain Rue*,' and Apuleius Platonicus gives *armala* as the Syrian name of *Ruta hortensis*, or Garden Rue. He mentions Peganon agrion separately, and says the Italians call it *Ruta montana.*

cold humours, such as palsy, lumbago, &c.; it is also said to stimulate the sexual system both in the male and female, increasing the flow of milk and menses in the latter. For administration a concentrated decoction is mixed with sweet oil and honey, or the crushed seeds are boiled in wine down to one-fourth of the original bulk of the latter, and the mixture strained (*vide* Makhzan-el-Adwiya, article Hurmal). Dr. P. Gopál, who has experimented with this drug, informs us that the infusion or tincture acts as a stimulant emmenagogue, and produces slight intoxication like *Cannabis indica*. He gave the tincture in ½ drachm doses to a female suffering from amenorrhœa, and it had the effect of producing a free menstrual discharge; he further says that it is sometimes used by the native midwives to procure abortion. Dr. Gopal believes that it has properties in common with Ergot, Savine, and Rue. The equal activity of watery and spirituous preparations may be explained by the fact that the red resinous colouring matter is a secondary product formed by the oxidation of the alkaloid Harmaline; it is only produced after digestion of the seeds in spirit. In Persia *P. Harmala* is called Sipand; when sprinkled upon burning coals it is supposed to avert the malignant influence of the evil eye. Popular allusions to it in Persian books are frequently met with.

Description.—The drug, as found in the bazaar, consists of the seeds mixed with a few pedicels surmounted by the five-partite calyx and portions of the three-celled, three-furrowed capsule. The seeds are of a dull greyish brown colour, irregularly angular, and about ⅛ of an inch long; they have a heavy narcotic odour when crushed, and a bitter taste.

Microscopic structure—The testa, which is rough and squamous, may be seen to consist of two rows of large honeycombed cells, the walls of which contain brown colouring matter. The kernel is greenish, and when a section is placed in glycerine for examination, it immediately developes a fine

green fluorescence; it consists of two longish cotyledons surrounded by albumen; the cell contents of both appear granular.

Chemical composition.—Some seeds crushed, and treated with water for a few minutes, produced after filtering a pale yellow fluid with a marked green fluorescence; this was destroyed by alkalies and restored by acids. A further examination of the seeds was made by exhausting them with rectified benzine, rectified spirit, and water acidulated with hydrochloric acid. The benzine solution was of a pale yellow colour, and upon evaporation yielded a rich reddish brown oil, having no very marked odour, and a nauseous taste. The tincture made with rectified spirit was of a deep red, like Tra. Lavandulæ Comp., very opaque and highly fluorescent. Upon evaporation it yielded a soft extract of the colour of Dragon's blood, and having the odour of *Cannabis indica*. This, when exhausted with water, gave a pale red solution with a green fluorescence, which, when treated with a solution of oxalate of ammonia, threw down the red colouring matter and became pale yellow, but retained its fluorescence. The remainder of the spirituous extract, after complete exhaustion with water, consisted of a soft resin of a deep carmine lake colour, having a heavy narcotic odour like resin of *Cannabis indica*. The portion treated with acidulated water yielded a pale sherry-coloured fluorescent solution, which, upon evaporation, gave a soft yellow extract, with an odour like honey; the greater part of this dissolved in rectified spirit, forming a yellow fluorescent solution; this, after filtration, was evaporated to a thin syrup, and upon cooling formed a dark brown mass. The seeds contain two alkaloids, *Harmaline*, $C^{13} H^{14} N^2 O$, discovered by Gobel in 1837, and *Harmine*, $C^{13} H^{12} N^2 O$, discovered by Fritzsche in 1847. The yield of the two alkaloids according to Fritzsche is 4 per cent., of which one-third is Harmine and two-thirds Harmaline. These two substances have been recently examined by O. Fisher and E. Taeuber (*Ber. d. Chem. Gesselsch.*, 1885, 400, 406). Harmaline crystallises from its solution in methylic alcohol in yellowish scales little soluble in water or ether,

soluble in cold alcohol, and very soluble in boiling alcohol; it colours the saliva yellow. It melts at 238° C., and is decomposed; heated with strong sulphuric acid it forms Harmaline-sulphuric acid, which on the addition of water, gives a fine blue fluorescence. Treated under pressure with fuming hydrochloric acid it yields *Hermatol*, which forms orange-red crystals sparingly soluble in water. This solution is strongly fluorescent and is probably identical with the yellow colouring matter of the seeds. Harmaline forms with acids crystallizable yellow salts soluble in water, to which they communicate a remarkable fluorescence. Harmine which exists in the seeds, is also obtained by oxidizing Harmaline with nitric acid. It crystallizes in colourless needles almost insoluble in water and very little soluble in cold alcohol or ether; it fuses at 256° C., and is partly sublimed and partly decomposed. Fuming hydrochloric acid converts it into *Harmal*, the acid solution of which is fluorescent. Oxidised by means of chromic acid it yields Horminic acid, $C^{10} H^{8} N^{2} O^{4}$, which crystallizes in silky tufts.

Commerce.—Hurmal seed is imported from Persia, but the plant has been introduced into India by the Mahometans, and in some places has run wild. In Southern India Henna seeds under the name of *Iswand* are used as a substitute for this drug. Value, Rs. 2½ per Surat maund of 37½ lbs.

ZANTHOXYLUM RHETSA, *DC.*

Fig.—*Rheede, Hort. Mal.* v., t. 34. Indian prickly Ash (*Eng.*), Clavalier d'Inde (*Fr.*).

Hab.—Western Peninsula.

Z. ALATUM, *Roxb.*

Hab.—Sub-tropical Himalaya.

Z. ACANTHOPODIUM, *L*

Hab.—Sub-tropical Himalaya.

Z. OXYPHYLLUM, *Edgw.*

Hab.—Temperate and sub-tropical Himalaya.

Z. HAMILTONIANUM, *Wall.*

Hab.—Assam and Burma.

Z. BUDRUNGA, *Wall.*

Hab.—Tropical Himalaya.

The carpels.

Vernacular.—*Z. Rhetsa,* Rhetsa-maram (*Tam.*), Rhetsa-maum (*Tel.*), Jimmi-mara (*Can.*), Tisal, Triphal, Chirphal (*Mar.*). *Z. alatum* and *Z. acanthopodium,* Tambul (*Beng.*), Nipáli-dhanya, Tumra, Tejphal, Darmar (*Hind.*). *Z. Budrunga,* Badrang (*Hind.*).

History, Uses, &c.—Sanskrit writers call the carpels of *Z. alatum* and *Z. acanthopodium* by the name of Tumburu, which signifies "coriander"; the fruits of these trees are so similar in appearance that they can hardly be distinguished. They have the peculiar flavour of coriander, and are about the same size as that fruit. In Hindu medicine they are considered to be hot and dry. The Chinese also use the carpels under the name of Hwa-tseaou or "Pepper flower," and in Japan the carpels of *Z. piperitum* are used. The Arabians appear to have obtained the carpels of *Z. alatum* or *acanthopodium* first from Northern India. Ibn Sina under the name of Fághireh (open-mouthed) describes them as "a berry the size of a chick pea containing a black seed as large as a hemp seed, brought from Sakála in Hindustan." Sakala or Sangala was an ancient town in the Punjab, near the modern Sanglawala Tiba or Sangla Hill. It is the Sangala of Alexander, and was visited by the Chinese pilgrim Hwen Thsang in A. D. 630; it had then a large Buddhist monastery and a stupa 200 feet high. Háji Zein el Attár, who wrote A.D. 1368, gives a similar account of Fághireh, and says that the

Persians call it Kabábeh-i-kushádeh (open-mouthed cubebs). The fruits of a *Zanthoxylum* are figured by Clusius under the name of Fagara Avicennæ in his *Arom. Hist.*, Ed. 1605, p. 185, but they are probably those of *Z. Rhetsa*. The true Fagara Avicennæ is the Fagara minor of the old Pharmacologists. Later Mahometan writers speak of a Faghireh coming from South India, and doubtless allude to the carpels of *Z. Rhetsa*, a large tree of the Western Peninsula which derives its botanical name from the Telugu word Rhetsa, "an assembly." Roxburgh tells us that the elders amongst the Telugu people meet under this tree to settle disputes, it is therefore called Rhetsa-maum or "assembly tree." *Z. Budrunga*, a tree of the tropical Himalaya, has carpels which can hardly be distinguished from those of *Z. Rhetsa*. The Mahometan physicians consider Fághireh to be hot and dry, and to have astringent, stimulant, and digestive properties. They prescribe it in dyspepsia arising from atrabilis, and in some forms of diarrhœa. The inhabitants of Southern and Western India use the carpels of *Z. Rhetsa* as a condiment, especially with fish; as a medicine they are given in honey for rheumatism, and the essential oil as a remedy for cholera These carpels are the Fagara major of the old pharmacologists, and are much larger than those described by Ibn Sina. The fruits of *Z. oxyphyllum* and *Z. Hamiltonianum* are also used: they are so similar to one another in appearance as to be hardly distinguishable. Besides its medicinal uses, Fagara minor is used as an ingredient in *Garáku* (tobacco for the *hukka*), and in the preparation of ground bait for fishing. The bark of these trees is tonic and aromatic, and may be used with advantage in rheumatism and in atonic dyspepsia; the root bark is to be preferred. Heckel and Schlagdenhauffen (*Académie des Sciences, Ap. 21st,* 1884,) reported that a crystalline principle, obtained from the bark of a West Indian *Zanthoxylum*, produced in frogs, rabbits, &c., general paralysis and abolition of the functions of respiration and circulation. (*See Berberine, p.* 66.)

Description.—The fruits of *Z. alatum* and *Z. acanthopodium* consist of the carpels usually dehiscing and empty, but

sometimes enclosing the round, black, shining seed. In perfect specimens we find a slender pedicel supporting the carpels, which are nominally four* in number, but of which at least one or two are mostly abortive. The carpels are oval or nearly spherical, $\frac{2}{10}$ths of an inch in longest dimension; externally they are of a bright reddish-brown, covered with prominent tubercles filled with oleo-resin; internally they are furnished with a hard, papery, white membrane, which becomes loose, contracts and curls up when the seed falls. The drug has an aromatic taste (at first like coriander) and an agreeable aromatic odour. The fruits of *Z. Rhetsa* and Budrunga are of the same shape, but as large as a pea, and the external surface of the carpel does not show the prominent tubercles above mentioned, but is finely wrinkled, of a reddish-brown colour, and not lined with a hard white papery membrane. The taste is at first like that of lemon peel, but afterwards extremely pungent like that of *Z. alatum*, producing much the effect of Pyrethrum upon the palate. The fruits of *Z. oxyphyllum* and *Z. Hamiltonianum* are of the same size as those of *Z. alatum*, but sessile and without prominent tubercles; they are of reddish-brown colour, and have a fine wrinkled surface like *Z. Rhetsa*; a hard, white papery membrane is present which becomes loose and contracts when the seed falls. In taste they resemble *Z. Rhetsa*. The shining black seeds of all these species have a feeble peppery taste. Sections of the capsules when magnified show that their elasticity is due to the presence of strong bands of spiral fibres. The dry open capsules when soaked in water resume the shape that they had before dehiscence.

The root bark of *Z. Rhetsa* is of a reddish-brown colour, and is covered with a light yellow suber, which easily separates in papery flakes; it has an agreeable aromatic odour and a bitter taste.

Chemical composition.—The bitter crystalline principle present in the bark of the Zanthoxyleæ, and formerly called *Zanthopicrite*, has been recognised as identical with berberine

by Dyson Perrins. (*Trans. Chem. Soc.*, 1862.) The bark also contains a volatile oil and resins. Dr. Stenhouse has obtained from the carpels of *Z. alatum* by distillation an essential oil to which the aromatic properties are chiefly due. This oil, which when pure is called by Dr. Stenhouse *Zanthoxylene*, is a hydrocarbon isomeric with oil of turpentine. It is colourless, refracts light strongly, and has an agreeable aromatic odour, similar to that of Eucalyptus oil; its composition is $C^{10} H^{8}$. He also obtained a stearopten, *Zanthoxylin*, floating on the water distilled from the carpels and separable from the crude essential oil. After repeated crystallizations from alcohol, zanthoxylin may be obtained in a state of purity, and then presents the form of large crystals of a fine silky lustre, insoluble in water, but readily soluble in alcohol or ether. It has a very slight odour of stearine, and a slightly aromatic taste. It distils unchanged, its fusing point before and after distillation remaining the same, namely, 80° C., and its solidifying point 78° C. Its composition is $C^{40} H^{6} O^{4}$ The essential oil was obtained by Pedler and Warden (1888) by distilling the crushed carpels with seeds, in a current of steam. The oil was dehydrated by fused $Ca\,Cl^{2}$. It commenced to boil at 175°—176° C., the greater part passing over between 176°—179° C., the temperature then rose to 181° C. and rapidly to 183° C., when the distillation was stopped. The rectified oil had a specific gravity of ·873 at 15·5 C. Its vapour density determined by Meyer's method was 5·43. They were unable to obtain the crystallizable stearopten isolated by Stenhouse. The freshly distilled oil exposed to 0° C. failed to deposit any crystals. In addition to the essential oil, they also detected the presence of a pale yellow viscid non-drying oil, an acid resin, and a yellow acid principle, forming deep yellow solutions with alkalies and reprecipitated from its alkaline solution by acids

Several species of Evodia bear capsules very similar to those of Zanthoxylum, notably *E. fraxinifolia*. An oil, supposed to have been yielded by these capsules, was recommended by Helbing (*British Pharm. Confer.*, 1887,) as a deodorant for iodoform; but the fruit of *E. fraxinifolia* does not agree with

Helbing's description, nor does it yield an oil of the nature described by him. The seeds of *F. fraxinifolia* are brown.

TODDALIA ACULEATA, *Pers.*

Fig.—*Rheede, Hort. Mal.* v, 41; *Wight Ill. t.* 66; *Lam. Ill.* ii., 116; *Bentl. and Trim, t* 49. Espinho do ladrão (*Port.*), Patte de poule (*Fr.*).

Hab.—Sub-tropical Himalaya, Western Peninsula, Ceylon. The root and fruit.

Vernacular.—Milakaranai (*Tam.*), Konda-kashinda (*Tel.*), Kúdúmiris-wel (*Cing.*), Káneh, Dahan (*Hind.*), Lumri (*Mar.*), Kaka-toddali (*Mal.*).

History, Uses, &c.—This scandent shrub appears to have been one of the plants known to Sanskrit writers as Kánchana or golden, on account of the orange colour of its fruit. It was also called Dahana or burning, on account of the pungency of its berries; both of these names are still in use in the vernacular. Rheede says that the unripe fruit and root are rubbed down in oil to make a liniment for rheumatism. Ainslie mentions its use in Southern India. He says:—"Malakarunnay (*Scopolia aculeata, Smith,*) is the Tamool name of a small white root about the third part of an inch in diameter, the bark of which is bitter, pungent and sub-aromatic, and is considered as stomachic and tonic. It is given in a weak infusion to the quantity of half a teacupful in the course of the day; the leaves are also sometimes used for the same purpose." Roxburgh, in the *Flora Indica*, describes the plant fully, and says: "That every part of this shrub has a strong pungent taste; the roots, when fresh cut, particularly so. The fresh leaves are eaten raw for pains in the bowels; the ripe (unripe) berries are fully as pungent as black pepper, and with nearly the same kind of pungency; from these the natives prepare an excellent pickle." The fresh bark is administered by the Telinga physicians for the cure of that

sort of remittent commonly called "hill fever." Flückiger and Hanbury have the following account of the history of Toddaliæ Radix:—"It is from this and other species of Toddalia, or from the allied genus Zanthoxylum, that a drug is derived, which, under the name of Lopez root, had once some celebrity in Europe. This drug was first made known by the Italian physician Redi, who described it in 1671 from specimens obtained by Juan Lopez Pigneiro at the mouth of the river Zambesi, in Eastern Africa, the very locality in which, in our times, *Toddalia lanceolata, Lam.*, has been collected by Dr. Kirk. It was actually introduced into European medicine by Gaubius in 1771 as a remedy for diarrhœa, and acquired so much reputation that it was admitted to the Edinburgh Pharmacopœia of 1792. The root appears to have been sometimes imported from Goa, but its place of growth and botanical origin were entirely unknown, and it was always extremely rare and costly. It has long been obsolete in all countries except Holland, where, until recently, it was to be met with in the shops." In the Pharmacopœia of India it is stated that Toddaliæ Radix is probably a remedy of great value in constitutional debility, and in convalescence after febrile and other exhausting diseases. It is very strongly recommended by Dr. Bidie, of Madras. The French in India use it under the name of *Bois de ronce.*

Description.—The root is woody and in cylindrical flexuose pieces, from ½ to 2 inches in diameter. The bark is about $\frac{1}{12}$th of an inch thick, and consists of a soft, yellow, corky external layer, wrinkled longitudinally, a thin bright yellow layer, and a firm brown middle cortical layer and liber. The wood is hard, yellow, and without taste or smell: its pores are arranged in a concentric manner, and the medullary rays are numerous and narrow. The flowers are white, scented, in simple or compound racemes, and are succeeded by 3 to 5-celled orange-coloured berries as large as a pea, and having a hot peppery taste when unripe. The dry berries are dark brown or nearly black, and have a pungent, aromatic, and very agreeable flavour like citron. When magnified the bark shows

a number of large cells filled with oleo-resin. Some cells contain raphides. The vascular system is loaded with oleo-resin.

Chemical composition.—The bark contains a resin, and an essential oil in flavour recalling oil of citron, also a bitter principle. In the aqueous infusion, tannic acid produces an abundant precipitate of the bitter principle, which probably is of an indifferent nature. Flückiger and Hanbury were unable to detect berberine in the bark. On distillation the leaves yield a pale yellowish green limpid oil, having the odour of citron peel, and a bitter and aromatic taste. The specific gravity at 17° C. is ·873; examined by polarized light in a tube of 200 m. m it rotates 15°·30′ to the left. The oil has no constant boiling point, but the greater part distils over between 190° and 210°. Metallic sodium has a slight action upon it which causes a yellow colour, and a white deposit in the oil. Sulphuric acid instantly changes it to a rich brown, and nitric acid strikes a transient pink. The oil readily dissolves iodine, and its solution in alcohol is not affected by ferric salts. It absorbs dry hydrochloric acid with considerable rise of temperature and deepening of colour, but no crystals were observed in the mixture after reposing a few days with an excess of the gas.

MURRAYA KŒNIGII, *Spreng.*

Fig.—*Wight Ic., t.* 13, *Roxb. Cor. Pl. II., t.* 112. Curry leaf tree (*Eng.*).

Hab.—Himalaya, Bengal, Western Peninsula, Ceylon.

Vernacular.—Karhi-nimb, Jhirang, Jirani (*Mar.*), Gora-nimb (*Guz.*), Ganda-nim (*Punj.*), Katnim (*Hind.*), Karibevu (*Can.*), Karu-veppilai (*Tam.*), Kari-vepachettu (*Tel.*), Barsunga (*Beng.*).

History, Uses, &c.—This small tree, in Sanskrit Saurabhi-nimba, or fragrant Neem, is found wild in

mountainous districts, and is also much cultivated for the sake of the leaves, which are much used as a condiment. The bark and root have stimulant properties, and are applied externally to parts bitten by venomous animals; the leaves are given raw in dysentery, and are also applied externally to cure eruptions. (*Roxb.*) An infusion of the toasted leaves, according to Ainslie, is used by the Hindus to stop vomiting. The plant is noticed in the Pharmacopœia of India as having tonic and stomachic properties. The leaves are much used as an ingredient in sauces and are sometimes given in decoction with bitters as a febrifuge. Judging by the Marathi names, it must be one of the plants used as condiments and described by Sanskrit writers under the name of Jarana or Jirana.

Description.—The leaves are pinnate with numerous leaflets which are 1¼ inch to 2 inches long, alternate, unequally oblique at the base, irregularly ovate, serrated, pubescent, upper surface dark green, dotted, under surface of a lighter colour, venation reticulated, petioles reddish, odour powerful, taste moderately pungent, bitter, and acidulous. The roots spread widely and send up numerous suckers; they have a thick soft bark, the parenchyme of which is loaded with oil globules. It has an agreeable odour and taste like fresh ginger.

The leaves yield to distillation a small quantity of volatile oil resembling that obtained from the leaves of *Ægle Marmelos.*

Chemical composition.—As a considerable quantity, 28 pounds, of the leaves had been previously distilled with water and yielded only a few drops of oil, it was not thought necessary to extract with petroleum ether. A weighed quantity, 80 grams, of the sun-dried and powdered leaves was exhausted with ether, and a measured quantity evaporated, dried and weighed, yielded a greenish-black resin equivalent to 7½ per cent. of the leaves. The bulk of the ethereal extract was allowed to evaporate by exposure to the air, and the residue was instantly mixed with freshly ignited pumice, and extracted

with water. A measured quantity, evaporated, dried and weighed, yielded a small residue equivalent to 3 per cent. of the resin. The aqueous extract was slightly acid to litmus, precipitated by acetate of lead, darkened by iron salts, but not precipitated by gelatine. It reduced Fehling's solution.

The residue from the aqueous extract was dried and exhausted with alcohol, in which it was completely soluble. This alcohol extract allowed to evaporate, yielded a greenish-black resin, of bitter taste, and peculiar odour. It was freely soluble in chloroform, bisulphide of carbon, benzol and amylic alcohol, less soluble in glacial acetic acid and petroleum ether, and almost insoluble in acetic ether. These solutions allowed to evaporate failed to produce anything crystalline, but left the unaltered resin. Treated with sulphuric acid the resin gives an emerald green coloration. It is readily oxidized and attacked by nitric acid, dense red fumes being evolved with considerable frothing, forming a deep red solution, which gives a yellow precipitate on pouring into water, soluble in a larger portion of hot water with yellow solution. The remainder of the acid solution evaporated to dryness, and the yellow residue neutralized with solution of caustic potash, gives a deep red liquid, which is precipitated by sulphate of copper and coloured a deeper red by cyanide of potash. It stained the skin, and dyed silk and flax a yellow colour, the yellow colour of the silk being permanent on washing in water. On heating a portion of the yellow acid residue in a crucible covered with a watch glass, a yellow crystalline sublimate was obtained. These reactions prove the presence of picric acid.

The resin was unaffected by boiling aqueous potash, but dissolved in alcoholic potash. After digesting a day, the potash solution was shaken up with ether; between the ethereal and aqueous solution a layer of fine crystals was observed, but in too small quantity for examination. The ethereal solution evaporated yielded some resin apparently unaltered. A portion of the potash solution poured into water separated some resin as a greenish-yellow powder. Another portion treated with

excess of acid separated the resin apparently unchanged. The dried residue of the ethereal extract was exhausted with absolute alcohol and a measured quantity evaporated, dried and weighed, yielded a residue equivalent to $2\frac{1}{2}$ per cent. of the leaves. The alcoholic extract was completely soluble in water, and gave similar reactions to the aqueous extract of the resin. It was slightly acid to litmus, and of a bitter taste. On acidifying with sulphuric acid and shaking with solvents, chloroform removed a slight residue of a greenish-black colour and uncrystalline. On concentrating the acid solution and setting aside, a few granular crystals separated; these were washed with a little alcohol and recrystallized, forming tufts of acicular crystals. They gave a yellow coloration with caustic potash, but were not coloured by either cold or warm sulphuric acid. They were sparingly soluble in water and alcohol. The aqueous solution was precipitated by tannin and acetate of lead. It slightly reduced Fehling's solution and gave an orange precipitate with a ferroso-ferric salt. It was not precipitated by Mayer's re-agent, nor by bi-iodide of potash. Ferric chloride produced no coloration or precipitate. The mother liquor from the above crystals was allowed to evaporate, and dried up to a bitter black extract. The crystalline principle is probably a glucoside, and might be provisionally named Kœnigin. (*J. G. Prebble.*)

Murraya exotica, *Linn.*, *Wight Ic. t.* 96. China Box, Honey bush (*Eng.*), Buis de Chine (*Fr.*). *Vern.*—Bibsar (*Hind.*), Kámini (*Beng.*), Kounti (*Mar.*), Naga-golugu (*Tel.*), Murchob (*Kumaon*), is a favourite evergreen shrub in gardens, which bears large bunches of sweet-smelling flowers like orange blossom. It has pinnate leaves with coriaceous leaflets, much resembling box leaves in shape, taste and odour. De Vrij has separated a glucoside from the flowers, which he has named *Murrayin*; its composition is $C^{18} H^{22} O^{10}$.

ATALANTIA MONOPHYLLA, *Corr.*

Fig.—*Wight Ic., t.* 1611; *Rheede, Hort. Mal. iv., t.* 12. Wild Lime (*Eng.*)

Hab.—Sylhet, Western Peninsula, Ceylon.

Vernacular.—Matanguár, Mákar-limbu (*Mar.*), Kat-ili-micham (*Tam.*), Adivi-nima (*Tel.*), Katunimbe-gida (*Can.*).

History, Uses, &c.—Rheede says that an oil of the leaves is cephalic, the root antispasmodic, and the juice of the fruit anti-bilious. According to Loureiro, the root is heating, resolvent and stimulant.

Ainslie tells us that a warm, pleasant smelling oil is prepared from the berry of this plant, which in Southern India is considered a valuable external remedy in chronic rheumatism and paralysis. In the Concan the leaf-juice is an ingredient in a compound liniment used in hemiplegia. (*Vanaushadi Prakasha*, 1, 404.)

Description.—*A. monophylla* is a large, thorny, climbing shrub, common on the hills of the W. Peninsula and in Sylhet; the leaves are fragrant like those of the orange; the berry is globular, yellow, about 1 inch in diameter and divided into four cells by membranous septa, one cell is generally abortive; pulp like that of a lime but very scanty; each cell contains one seed ¾ of an inch long and ½ an inch broad, having one convex and two flat surfaces like the segment of an orange; the rind of the fruit has a faint odour of orange peel and abundant oil cells. The oil prepared by the natives is obtained by powdering the seeds, which are very aromatic when fresh, sprinkling them with sweet oil and expressing; the result is a dark green, pleasant smelling oil, which communicates an agreeable warmth to the skin when rubbed on it. The seeds pressed by themselves yield no fatty oil, but the press cloths are moistened with essential oil. A similar preparation is made from the seeds of *Limonia alata, W. & A.*, in the Nilgiris, and a decoction of the leaves of the same plant is applied to cure itch; its Tamil name is Kurunthu.

LIMONIA ACIDISSIMA, *Linn*

Fig.—*Rheede, Hort. Mal. iv., t.* 14; *Roxb. Cor. Pl., t.* 86.

Hab.—Himalaya, Behar, Assam, W. Peninsula. The fruit.

Vernacular.—Beli (*Hind.*), Tor-elaga (*Tel.*), Nai-bél (*Mar., Can.*).

History, Uses, &c.—Rheede calls it 'Tsjerou-katou-naregam,' and gives 'Limonis da folha cruzado' as the Portuguese name. Regarding its medical properties he says: "Cæterum arboris hujus folia præsentaneum habentur curandæ epilepsiæ remedium. Radix alvum movet, sudores expellit, nec non cruciatibus colicis et cardialgiæ medetur. Fructus siccati stomachum roborant, ac alimentorum in eo fermentationem læsam restituunt; adhæc aeri ex variolis, febribusque malignis et pestilentialibus contagiosa potenter resistunt, atque variis venenis præstantissimum censentur antidotum; quamobrem magni æstimantur, et ab Arabibus aliisve mercatoribus avide expetuntur." Graham, Drury and others copy from Rheede, but Drury adds that the fruit is used in Java instead of soap. (*Cf. Rumphius.*) This use of the fruit is known in India, and is indicated by the Marathi name which signifies "barber's Bael fruit."

Description.—*A. acidissima* is a shrub with tripinnate leaves and winged petioles; the root is yellow, bitter and aromatic; the fruit globular, the size of a grape, with yellowish-red rind like that of the lime in structure, and a scanty very acid flesh-coloured pulp with some bitterness and aroma; it is four-celled, but usually contains only three seeds of the colour of orange pips. The fruit is eaten as a stomachic by the hill tribes, but is not seen in the Bombay market. The cultivated *sour lime* in a dried state is often offered in large quantities. It is exported to the Arabian coasts, where it is used as a condiment with fish, meat, &c., being powdered along with the spices commonly used in cooking.

Paramignya monophylla, *Wight, Ill. i., t.* 42, a scandent shrub of the Sikkim Himalaya, Bhutan, Tenasserim, W. Peninsula, and Ceylon, has a reputation as an alterative and diuretic. The root, which is the part used, has a scabrous brown bark and a bitter saline taste; it abounds in large crystals of oxalate of lime. From the resemblance of the fruits to those of *Capparis zeylanica,* the Marathas call it Karuwageti (bitter Wagoti). In the Concan the root is given to cattle suffering from bloody urine.

Kakkola.—This is the Sanskrit name of a rutaceous berry, apparently that of **Luvunga scandens,** *Ham.* The berries, as sold in the shops, have a glandular papillose exterior, and a terebinthinate odour and taste; they vary much in size, and contain from one to four dark green, oily seeds with a membranous testa, of the size and shape of orange pips. The berries are used in preparing a perfumed medicinal oil (Kakkolaka), and are sold in the bazaars of Bengal under the name of Kákála; they must not be confounded with Kshirakákkoli, a pseudo-bulb from Nipal, composed of from 8 to 10 ovoid fleshy scales. Kakkola and Kshirakákkoli are chiefly of interest as being the only two constituents of the *Ashtavarga* or 'group of eight medicines' which are known to the modern Hindus. The Sanskrit names of the other six plants are, Rishabha, Jivaka, Meda, Mahameda, Riddhi and Vriddhi.

CITRUS, *Several species.*

Fig.—*Bentley* and *Trim., tt.* 50 *to* 54. Orange (*Eng.*), Oranger (*Fr.*), Lemon (*Eng.*), Citronnier (*Fr.*), Citron (*Eng.*), Cedratier (*Fr.*). The fruit.

Hab.—India, universally cultivated.

Vernacular.—Narangi, Oranges; Limú, Lemons; Turúnj, Mahalung, Citrons (*Hind., Bomb.*). Kich-chilip-pazham, Oranges; Elumich-cham-pazham, Lemons; Nara-dabba, Citrons (*Tam.*). Kich-chili-pandu, Oranges; Pedda-nimma-

pandu, Lemons; Bijapura, Citrons (*Tel.*). Kittale, Oranges; Dodda-nimbe, Lemons; Mada-lada, Citrons (*Can.*).

History, Uses, &c.—Bitter oranges and lemons were introduced into Europe from India by the Arabians, and were used by Avicenna and the early Arabian physicians medicinally. The sweet orange was introduced from China by the Portuguese, who much improved it by cultivation, hence the European name of *Portogallotto* for this orange, and the Indian *Sangtara*, a corruption of Cintra, the name of a mountain valley near Lisbon, where the orange grows in great perfection. The Portuguese appear to have introduced the Cintra variety of orange into India towards the end of the 17th century. According to Dutt (*Hindu Materia Medica*, p. 126,) the different species of Citrus described by Sanskrit writers are as follows:—

Jambira,	*Citrus acida*,	*Roxb. Var.*	3
Limpáka,	*do.*	*do.*	1
Nimbuka,	*do.*	*do.*	2
Vijapura,	*do.*	*do.*	7
Madhukarkatika,	*do.*	*do.*	9
Mahalunga,	*Citrus medica.*		
Karuná,	*do.*	*do. Var.*	
Nagaranga,	*Citrus Aurantium.*		

"The variety of *Citrus acida*, called Jambira, yields the lemon juice used in medicine. Limpáka is much used as a sauce by the natives. The fruits are cut vertically into two pieces, and the fresh juice is sprinkled on soup, dal, curry, &c., to which it imparts a pleasant acid taste and agreeable flavour. A pickle of this fruit in its own juice and salt is a popular and effectual medicine for indigestion brought on by excess in eating, or by indigestible articles of diet. The fruits are first rubbed upon a stone, or their rind scraped a little so as to thin it; they are then steeped in juice obtained from other fruits of the sort, and exposed to the sun for a few days with the addition of common salt; when crisp and of a brown colour, they are preserved in jars. This preparation is called Járak nebu

(digestive lemon) in Bengal. The variety called Nimbuka has larger fruit than Limpáka, and is also used as sauce, like the latter, but is inferior to it in flavour and fragrance. *Citrus Aurantium* is called Kamla nebu in Bengali; the variety grown in the plains has an acid taste, and is called Nárengá. The Sanskrit term Karuná nimbu is variously translated by different authorities. Wilson in his Sanskrit Dictionary calls it *Citrus decumana.* In the Hortus Bengalensis it is translated *Citrus medica,* while Drury and other Madras authorities make it *Citrus limonum.* The Sabdakaldruma does not give any synonym or vernacular term for it, so that it is difficult to say what form is really meant. In the vernacular the term Káruna is applied to a variety of *Citrus medica* (in the Makhzan-el-Adwiya it is given as the Hindi for Naranj), *Citrus decumana* has no Sanskrit name. In the vernacular it is called Batavi nebu, from its having been orignally brought from Batavia. Madhukarkatika is probably the sweet lemon, or possibly the citron. Lemon juice is considered cooling, refrigerant, stomachic and useful in dyspepsia, thirst, fever, &c. Fresh lemon juice is recommended to be taken in the evening, for the relief of dyspepsia with vomiting. It enters into the composition of several carminative medicines, such as the Hingváshtaka, &c. In rheumatic affections, such as pleurodynia, sciatica, lumbago, pain in the hip joints, &c. Sárangadhara recommends the administration of lemon juice with the addition of Yavakshára (impure carbonate of potash) and honey. The root of the variety of *Citrus acida,* called Limpaká, is one of the principal ingredients in a preparation of Iron called Yakridari lauha." The genus Citrus furnishes three out of the five acid fruits (*Phalâmla-panchaka*) of Sanskrit writers, *viz.*, limes, oranges, and citrons; the other two are tamarinds and sorrel. Mahometan writers divide the genus Citrus into Utrunj, citrons; Náranj, oranges; and Limú, lemons; they describe two varieties of Citron—the large, which is broad and obtuse at the base, and the small, both ends of which taper equally; both are yellow and fragrant, but the perfume of the small variety is greatest; the rind of both is bitter; the pulp of the small

bitter, of the large sweet. Citron rind is said to be hot and dry, the pulp cold and dry if acid, but cold and moist if sweet; the seeds, leaves, and flowers hot and dry. The juice is described as refrigerant and astringent, and is said to be digestive and to check bilious vomiting; the rind is tonic and digestive, and is best administered preserved with honey or sugar. The author of the Makhzan-el-Adwiya states that if the rind of a citron be steeped in a vessel of wine it will convert it into vinegar. He also quotes a Mahometan Hadis (tradition), to the effect that Satan will not enter a house in which citrons are kept. The essential oil is extracted by means of sweet oil from the powdered rind, it is considered hot and dry, and is used as a stimulating liniment. The essential oil of the flowers and leaves is extracted in the same way, and is considered to have the same properties. The seeds are generally stated to be alexipharmic. With regard to oranges, the Mahometan writers describe the best kind as large, thin-skinned, and smooth; they say that the rind and flowers are hot and dry, the pulp cold and dry, and recommend the fruit in colds and coughs, when febrile symptoms are present; it is best administered baked with sugar. The juice is valuable in bilious affections, and stops bilious diarrhœa. The orange is the safest of the acid fruits; the peel is useful for checking vomiting, and the prevention of intestinal worms. Orange poultice is recommended in some skin affections, such as psoriasis, &c. Oranges are considered to be alexipharmic and disinfectant, orange water stimulating and refreshing. The essence is extracted by oil from the rind and flowers, and is used as a stimulating liniment. Lemons are stated in the Makhzan-el-Adwiya to be of many kinds; those which are thin-skinned and about the size of a hen's egg are most esteemed; others are described as ovoid and as large as a goose egg. Of all, the juice is the most valuable part; the peel has the same properties as orange peel, but is weaker. The juice is stated to be cold and dry, or, according to some, cold and moist; to be detergent, useful in bilious headaches, and vomiting caused by excess of bile; to purify the blood in scorbutic states of the system; preserved with

sugar or honey lemons are recommended for sore throat, and are considered to act as a detergent; they are administered before purgatives to prepare the body for them, and afterwards to check excessive action. Hakíms pretend to dissolve jewels and pearls in the juice, and also in that of the citron. The seeds are said to be alexipharmic, and the leaves to have the same properties as those of the citron. Sweet limes and crosses with the orange and citron, produced by tying the trees together, are considered inferior in medicinal properties. Gibson tells us that the fruit of *Citrus Bergamia* (the common sour lime of India) eaten daily with salt, is a remedy of the utmost importance in enlargement of the spleen. Dr. Aitkin (*Brit. Med. Journ.*, Oct. 4, 1884, 653,) reports that a decoction of lemons proves to be a very valuable remedy in the treatment of ague. A dose is prepared by cutting a lemon into thin slices, adding three teacupfuls of water, boiling until reduced to one teacupful, and allowing the decoction to stand all night in the open air, when, after being strained, it is ready for administration, and should be given the first thing in the morning. This statement lends interest to an investigation by M. Tanret of some immediate principles in the rind of the bitter orange. (*See Chemical comp.*)

Microscopic structure of Orange and Lemon Peel.—The epidermis exhibits numerous stomata; the parenchyme of the pericarp encloses large oil cells, surrounded by small tabular cells. The inner spongy tissue consists of branched cells separated by intercellular spaces. The outer layers of the parenchyme contain numerous solid yellow bodies, which probably consist of Hesperidin; large crystals of oxalate of calcium are also to be seen, and in the interior tissue vascular bundles.

Chemical composition.—The following estimates of citric acid in East Indian limes has been kindly furnished to us by Mr. G. W. R. Criper, F. C. S., of Calcutta:—

1st, Chholonga, a large oblong fruit with a rough skin of a reddish-yellow colour (*Citrus medica, Roxb.*). One fruit

contains approximately 100 c. c. juice, = 6·3 per cent. acid calculated as citric.

2nd, China Páti, a round small fruit with a smooth skin of a yellow colour. (*Citrus acida, Roxb.*, var. 1.) One fruit contains 40—50 c. c. juice = 6·5 per cent. acid calculated as citric. 50 of these limes gave 69 fl. oz. juice.

3rd, Kághazi, a small oblong, smooth-skinned fruit, greenish to yellow in colour. (*Citrus acida, Roxb.*, var. 2.) One fruit contains 18—25 c. c. juice = 6·4 per cent. acid, calculated as citric.

4th, Páti, a small round smooth-skinned fruit of a yellow colour. (*Citrus acida, Roxb.*, var. 1.) One fruit contains about 40 c. c. juice = 7 per cent. acid, calculated as citric.

5th, Gora, an oblong rough-skinned fruit of a greenish colour. (*Citrus acida, Roxb.*, var. 3.) One fruit contains about 40—50 c. c. juice = 5·6 per cent. acid, calculated as citric.

6th, Sharbati (Sweet lime), a round smooth-skinned fruit of a pale yellow colour. (*Citrus acida, Roxb.* var. 9.) One fruit contains about 60 c. c. juice = 0·1 per cent. acid, calculated as citric.

The white spongy inner coating of lemons, as well as other fruits of the genus *Citrus*, contains a bitter principle, *Hesperidin*, discovered by Lebreton (*J. Pharm. XIX.*, 377), of which E. Hoffmann obtained 5 to 8 per cent. from unripe bitter oranges. He extracted them with dilute alcohol, after they had previously been exhausted by cold water. The alcohol should contain about 1 per cent. of caustic potash; the liquid on cooling is acidulated with hydrochloric acid, when it yields a yellowish crystalline deposit of hesperidin, which may be obtained colourless and tasteless by recrystallization from boiling alcohol. By dilute sulphuric acid (1 per cent.) hesperidin is broken up as follows:—

$C^{22}H^{26}O^{12}$ =	$C^{16}H^{14}O^{6}$	$C^{6}H^{12}O^{6}$
Hesperidin	Hesperetin	Glucose.

Hesperidin is very little soluble even in boiling water or in ether, but dissolves readily in hot acetic acid, also in alkaline

solutions, the latter then turning soon yellow and reddish. Pure hesperidin, as presented to one of us by Hoffmann, darkens when it is shaken with alcoholic perchloride of iron, and turns dingy blackish brown when gently heated with it. Under the same name Wiedemann has described a principle obtained from unripe oranges differing from ordinary Hesperidin in some respects, especially in being insoluble in alcohol.

Hesperetin forms crystals melting at 223° C., soluble both in alcohol or ether, not in water; they taste sweet. They are split up by potash into phloroglucin and *Hesperetic acid*, $C^{10} H^{10} O^4$. On addition of ferric chloride, thin slices of the peel are darkened, owing probably to some derivative of hesperidin or to hesperidin itself. The name hesperidin has also been applied to *yellow* crystals extracted from the Pomelo, *Citrus decumana, Linn.*, the dried flowers of which afford about 2 per cent. of this substance. It is, as shewn in 1879 by E. Hoffmann, quite different from hesperidin as described above; he calls it *Naringin*, and assigns to it the formula $C^{23} H^{26} O^{12} + 4 OH^2$. Naringin is readily soluble in hot water or in alcohol, not in ether or chloroform. Its solutions turn brownish red on addition of ferric chloride. Lemon juice in addition to citric acid contains 3 to 4 per cent. of gum and sugar, and 2 28 per cent. of inorganic salts, of which, according to Stoddart, only a minute proportion is potash. Cossa, on the other hand, who has recently studied the products of the lemon tree with much care, has found that the ash of dried lemon juice contains 54 per cent. of potash, besides 15 per cent. of phosphoric acid. Stoddart has pointed out the remarkable tendency of citric acid to undergo decomposition, and has proved that when lemons are kept for six months the acid rapidly decreases in quantity and finally ceases to exist, having been all split up into glucose and carbonic acid. Lemon juice may with certain precautions be kept unimpaired for months or even years. (*Pharmacographia*, 2nd Ed., p. 116.) To prevent fermentation it should be heated, strained to remove albumen, and stored in well filled bottles. In the

Calcutta market lime juice prepared by native manufacturers, and preserved with a small amount of salicylic acid, is largely sold. Juice containing less than 25 grains of free citric acid per fluid ounce is not passed for Government purposes, and the amount of salicylic acid has been fixed at one-fifth of a grain per fluid ounce. Some experiments were recently made by one of us on concentrating lime juice to one-fourth its original volume in order to facilitate transport. It was found that the loss of acidity in conducting the operation in metallic dishes over a naked flame, and on the water bath at varying temperatures, with constant stirring was 53·2 to 28·8 grams per gallon. The same juice concentrated without heat in vacuo over $H^2 SO^4$, indicated a loss of only 9·2 grams due to volatile acids. In the experiments in which heat was employed the total loss of acidity, though really partly due to volatile acids, was calculated as citric acid, and to render the results comparable the loss in vacuo over $H^2 SO^4$ was also calculated as citric acid. On the large scale without using vacuum pans a greater loss occurs. Warnecke found 5·85 per cent. of ash in immature orange fruit, 3·90 per cent. in the pulp of the ripe fruit, and 5·28 per cent. in orange peel when the white inner tissue had been removed. According to Boussingault, orange petals contain 5·00 per cent. of sugar capable of reducing copper solution. Several species of the genus yield an inferior gum resembling cherry-tree gum. By various treatment of an alcoholic extract of the peel, M. Tanret has succeeded in separating—

(*a*) A crystalline acid, insipid and non-volatile, insoluble in water and ether, slightly soluble in cold alcohol, but more soluble in boiling alcohol and chloroform, and having a composition represented by the formula $C^{14} H^{28} O^{14}$;

(*b*) A crystalline resinous body, extremely bitter, nearly insoluble in cold water, but freely soluble in boiling water and in ether, alcohol and chloroform, and having a composition approximating to that of hesperetic acid;

(*c*) A crystalline glucoside, isomeric with hesperidin, and named isohesperidin.

(*d*) Hesperidin; and (*e*) a glucoside to which the bitterness of the peel is attributed, and which has been named "*aurantiamarin.*" Aurantiamarin is soluble in all proportions in water and in alcohol, but is insoluble in ether and chloroform. It is the natural solvent of hesperidin and the bitter resin (*b*). (*Comptes Rend. cii.,* 518; *Pharm. Journ.* 1886.) The sugar produced when hesperidin and isohesperidin are split up under the action of acids is a mixture of glucose and insodulcite. (*Bull. Soc. Chim.* xlix., 1.)

The rind of the lemon yields the oil of lemon of commerce. The most delicate scented oil is procured by the *sponge process* in use in Italy and Sicily. After soaking in water to which a little soda has been added, the fruit are taken up singly, and firmly pressed against a large and hard-grained sponge. Two or three sharp turns of the wrist causes the sponge to rupture the oil cells in the rind, and the sponge absorbs the exuded oil. The sponge is pressed from time to time, and the expressed liquid allowed to settle, when it separates into three layers, the oil floating on the surface, bright and clear. In Southern France, an instrument called an écuelle is used, which consists of a shallow pan studded on its concavity with strong blunt spikes, and having a receptacle at its lowest part for the oil, and a lip on one side. In using the instrument the fruit is rolled by the hand gently and quickly over the spikes, when the oil separates and collects in the reservoir. Another plan of obtaining the oil is expression. The process of distillation is also used, but the product is inferior. A combined process in which the écuelle and distillation methods are used has been introduced, and it is claimed that while the product is equal in quality to that yielded by mechanical means, the yield is nearly double. One thousand lemons yield from 320 to 400 grams of oil, and about ten gallons of raw juce. Pure oil of lemons contains, according to Bouchardt and Lafont, besides a little cymene, several hydrocarbons, $C^{10}H^{16}$, the most abundant of which is a citrene boiling at about 178° C., and having a rotatory power exceeding + 105,° and yielding a solid optically inactive dihydrochloride.

Oil of limes, derived from the rind of *C. Limetta*, is obtained in a similar manner to oil of lemons, which it somewhat resembles.

Orange peel oil, the essence or oil of Portugal of commerce, is also obtained in a similar manner. Wright has isolated from the oil a terpene Hesperidene. (*J. Chem. Soc.*, 1873, p. 549.)

From the flowers of different varieties of the Orange, *oil of Orange flowers* is obtained. Genuine orange flower oil, the *Oleum Neroli* of pharmacy, is obtained by the maceration or absorption process from the flowers of the sweet or bitter orange. By aqueous distillation of the flowers oils are also obtained, but inferior in aroma to that yielded by the first mentioned methods. Thus *C. Aurantium* yields *oil of neroli*, the flowers of *C. bigaradia*, or Seville orange, *néroli bigarade*; while the leaves and young unripe fruit of different varieties of Citrus yield *néroli petit grain*. (Braunt.)

Orange flower water is used in pharmacy, and a tea made from orange flowers is much used in French domestic medicine.

Commerce.—The various species of Citrus are cultivated in most parts of India. The kinds usually met with are: several varieties of Mandarin orange; the common sweet orange; several varieties of sour lime; the sweet lime; the citron; and a fruit which appears to be a cross between the sour lime and orange. Besides these we have the Shaddock or Pummelo in abundance, and occasionally sweet citrons from the Persian Gulf, and sweet oranges from Suez or Zanzibar. Sour limes in a dried state are exported to Arabia, where they are used as a condiment with fish, meat, &c.

ÆGLE MARMELOS, *Corr.*

Fig.—*Bentl. and Trim.*, *t.* 55. Bael tree (*Eng.*), Egle marmel (*Fr.*). The fruit, bark, leaves and root.

Hab.—India.

Vernacular.—Bél (*Hind.*, *Beng.*, *Bomb.*), Vilva-pazham (*Tam.*), Bilva-pandu (*Tel.*), Bilapatri (*Can*), Bilinn-phal (*Guz.*).

History, Uses, &c.—This is a sacred tree amongst the Hindus, its leaves being used in the worship of Siva. On this account it is to be found cultivated everywhere in Hindu gardens. It is considered sacrilegious to destroy it; enormous quantities of the leaves are gathered for use in the temples at certain seasons. In ancient Sanskrit poems it is frequently alluded to as an emblem of increase and fertility, it is considered to be very auspicious (ati-mangalya). The baton of the Vaisya or third caste of Hindus is obtained from this tree. The fruit is the subject of several Solar-phallic myths.' Hindu physicians regard the unripe or half ripe fruit as astringent, digestive, and stomachic, and prescribe it in diarrhœa and dysentery. The ripe fruit is considered aromatic, cooling and laxative. A thick sherbet of the ripe fruit has a reputation among Europeans as an agreeable laxative; the dose is a tumbler-full. The dried pulp of the fruit is called Vilva peshika in Sanskrit. The root bark is used as a remedy in hypochondriasis, melancholia and palpitation of the heart, (diseases supposed to be caused by deranged air); it is one of the Dasamula or ten plants (*vide Tribulus terrestris*). The fresh juice of the leaves is given with honey as a laxative and febrifuge; it is used in asthmatic complaints, and with the addition of black pepper in anasarca with costiveness and jaundice; moreover, in external inflammations it is given to correct the supposed derangement of the humours. The Mahometans use the Bel as a medicine, and Muhammad bin Zakarieh describes it; they consider the ripe fruit to be hot and dry, the very young fruit cold in the second degree, and the half ripe fruit cold in the first and dry in the second degree; its properties are described in the Makhzan-el-Adwiya as cardiacal, restorative, tonic and astringent; it is directed to be combined with sugar for administration to prevent its giving rise to piles. The pulp of the half-ripe fruit baked and mixed with sugar and rose water when given on an empty stomach is said to be a good remedy for diarrhœa. Garcia d'Orta, physician to the Viceroy of Goa in the 16th century, describes the Bel fruit under the name of "Marmelos de

Benguala, and mentions its use in dysentery. Bontius also mentions it. Rheede in his *Hort. Malab.* (Vol. iii., p. 37,) notices its use on the Malabar Coast. Rumphius remarks that the gum is like cherry gum, it tastes at first sweet but afterwards slightly acrid. He also tells us that the Chinese make an extract of the leaves and young fruit which they use for adulterating opium. Ainslie and the author of the Bengal Dispensatory quote Rheede, but give no further information upon the use of the fruit in dysentery. In 1853, Sir R. Martin, writing in the *Lancet* (Vol. II., p. 53,) called the attention of the profession to it; finally, in 1869, it was made official in the Pharmacopœia of India, where it is recommended as a remedy of much value in atonic diarrhœa and dysentery and in the advanced stages of those diseases, in irregularity of the bowels, and in habitual constipation. In the Concan the small unripe fruit (Bál belphal) is given with fennel seeds and ginger in decoction for piles; a compound pill containing two parts each of Bál belphal, *Mimusops elengi* fruit, and galls, one part each of nutmegs, cloves, saffron, nágkésar and mace, is used as a remedy for diarrhœa; the dose is one pill for a child and three for an adult. Two tolás of the juice of the bark is given with a little cummin in milk as a remedy for poverty of the seminal fluid. The best preparation of Bael fruit is a marmelade made from the full grown but still tender fruit cut in thin slices; it keeps well, which is not the case with the conserve made from the pulp of the ripe fruit usually met with in the shops.

Description.—The fruit is a large berry, 2—4 inches in diameter, variable in shape, being spherical or somewhat flattened like an orange, ovoid, or pyriform, having a smooth hard shell; the interior divided into 10—15 cells, each containing from 6—10 woolly seeds, consists of a mucilaginous pulp, which is very aromatic, each seed is surrounded by a clear tenacious mucus. The commercial article is entire or in dried slices, having on the outer side a smooth greyish brown shell, enclosing a hard orange brown gummy pulp, in which the

cells and seeds may be seen; the latter are oblong and compressed, about 3 lines long, and covered with whitish hairs; the dried pulp has a mucilaginous, acid, and slightly astringent taste, and a very agreeable aroma, resembling that of elemi.

Microscopic structure.—The rind is covered with a grey cuticle or bloom, and further shows two layers, the one exhibiting not very numerous oil cells, and the other and inner made up of sclerenchyme. The tissue of the pulp consists of large cells. In the epidermis of the seeds certain groups of cells are excessively lengthened and constitute the woolly hairs already noticed.

Chemical composition.—As stated in the *Pharmacographia*, the dry pulp moistened with cold water yields a red liquid containing chiefly mucilage and (probably) pectin, which separates if the liquid is concentrated by evaporation. The mucilage may be precipitated by neutral acetate of lead or by alcohol, but is not coloured by iodine. It may be separated by a filter into a portion truly soluble (as proved by the addition of alcohol or acetate of lead) and another, comprehending the larger bulk, which is only swollen like Tragacanth, but is far more glutinous and completely transparent. Neither a per nor a proto salt of iron shows the infusion to contain any appreciable quantity of tannin. Warden remarks that the ripe and unripe fruit, when moistened with a solution of ferric chloride gives a marked tannic acid reaction, strongest in those portions of the pulp next the rind, the clear mucilage surrounding the seeds he found to have an acid reaction, to contain lime and to afford no tannin reaction. Warnecke found 2·08 per cent. of ash in Bael fruit, and 5·72 per cent. in the pulp separated from the rind. The wood has the following percentage composition:—

Soluble potassium and sodium compounds	·16
Phosphates of calcium and iron	·13
Calcium carbonate	2·16
Magnesium carbonate	·19
Silica with sand and other impurities	·01

—(*Warth., Indian Forester X.*, p. 63.)

28 lbs of the fresh leaves submitted to distillation in the usual manner, rapidly yielded one ounce of a thin mobile oil of a faint yellowish-green colour and neutral reaction, which had a peculiar aromatic odour and slightly bitter taste. It had a specific gravity of 0·835 at 32° C. and a boiling point of 175° C. Examined with the polariscope it turned a ray of polarized light to the left $(a)_D = -22·87$. The oil was miscible with carbon bisulphide in all proportions, readily soluble in alcohol, and one part in three of 81 per cent. alcohol. It gave a reddish-brown colour with sulphuric acid, a deep brown with sulphuric acid and potassium bichromate, a reddish coloration with fuming nitric acid. It dissolved picric acid when slightly warmed, and the solution had a deep orange colour; on cooling crystals were deposited. With a solution of bromine in chloroform it formed a colourless solution. Dissolved in carbon bisulphide, and nitric acid 1·2 added, the upper layer of bisulphide showed a greenish colour and the lower of acid a red colour. The oil dissolved iodine with explosive action, and was soluble in glacial acetic acid. (*H. R. Hoyles.*)

Commerce.—Value, dry fruit, ½ to Re. 1 per 100; green fruit 6 as. per 100; dry pulp, Rs. 20 per cwt. The Bombay market is chiefly supplied from the Deccan. The fruits are usually small and not suitable for the preparation of the conserve; for this purpose the large cultivated fruit of Bengal should be obtained in a fresh condition. Season --November and December.

FERONIA ELEPHANTUM, *Corr.*

Fig.—*Roxb. Cor. Pl.*, *t.* 141; *Wight Ic.*, *t.* 15. Wood Apple (*Eng.*), Pommier d' éléphant (*Fr.*).

Hab.—India. The leaves, fruit and gum.

Vernacular.—Kowit, Kavitha (*Hind.*, *Mar.*), Kathbel (*Beng.*), Nila-vilam (*Tam.*), Kotha (*Guz.*), Byalada (*Can.*), Nela-velaga (*Tel.*)

History, Uses, &c.—The Wood apple, or Elephant apple, so called because the fruit is like an elephant's skin, in Sanskrit Kapittha (on which monkeys dwell) and Kapipriya (dear to monkeys), is met with throughout India, and is cultivated for the sake of the fruit, which is edible. The Hindus consider the unripe fruit to be a useful astringent in diarrhœa and dysentery, and prescribe the ripe fruit in affections of the gums and throat. It is called Dadhiphala in Sanskrit, as its taste is compared with that of Dadhi or coagulated milk. The leaves are aromatic and carminative. The author of the Makhzan-el-Adwiya says that the leaves are very astringent, and have the taste and odour of Tarragon. He describes the fruit as cold and dry in the second degree, refreshing, astringent, cardiacal and tonic, a useful remedy in salivation and sore throat, strengthening the gums and acting as an astringent: sherbet made from the fruit increases the appetite, and has alexipharmic properties. The pulp applied externally is a remedy for the bites of venomous insects; if not obtainable, the powdered rind may be used Ainslie mentions the use of the fruit, leaves, and gum. He says that the latter supplies the place of gum Arabic in Lower India, and is prescribed by Tamool practitioners to relieve tenesmus in bowel affections. The *Feronia elephantum* is the Balong of the Portuguese. It is mentioned in the Bengal Dispensatory and Pharmacopœia of India, but no further information as to its properties is to be gathered from these works. The fruit when cultivated, attains a diameter of four inches. The gum forms part of the country gum which is sold in the bazárs. It is the Dadhittharasa of Sanskrit writers. Under the name of Pancha-kápittha, or five products of the Feronia, the Hindus prepare a medicine which contains the flowers, bark, root, leaves and fruit of the tree. The country people pound the leaves with curds and apply the mixture to the whole body as a remedy for heat of blood supposed to be caused by bile.

Description.—The ordinary wood apple is globose, one-celled, about 2½ inches in diameter, covered with a scurfy

epidermis, which is of a light grey or dirty white colour; beneath the epidermis, the rind is dull green, woody and granular, much more fragile than that of the Bél. The odour when ripe is aromatic, and resembles that of melon. There are about 500 seeds in each fruit of a bland taste and free from bitterness; they are embedded in a pale greyish-pink pulp, and are of an oblong compressed form, with thick fleshy cotyledons, and a radicle pointing away from the hilum. The leaves have from 5—7 leaflets, cuneate, or obovate with a crenate tip; they smell aromatic. The root bark is thick, white and starchy; it has the odour of the leaves and contains essential oil. The gum is in tears or irregular masses, yellow or brownish; dissolved in water it forms an almost tasteless mucilage, much more viscid than that of gum Arabic made in the same proportions. The solution reddens litmus, and is precipitated by alcohol, oxalate of ammonia, alkaline silicates, perchloride of iron, but not by borax. Moreover, the solution is precipitated by neutral acetate of lead or caustic baryta, but not by potash. If the solution is completely precipitated by neutral acetate of lead, the residual liquid will be found to contain a small quantity of a different gum, identical apparently with gum Arabic, inasmuch as it is not thrown down by acetate of lead. If the lime is precipitated from the Feronia mucilage by oxalate of potassium, the gum partially loses its solubility and forms a turbid liquid.

Chemical composition.—The larger portion of Feronia gum is not identical with gum Arabic; when examined in a column of 50 mm. length, it deviates the ray of polarised light 0°·4 to the right,—not to the left, as gum Arabic. Gum Arabic may be combined with oxide of lead; the compound (arabate of lead) contains 30·6 per cent. of oxide of lead, whereas the plumbic compound of Feronia gum dried at 110° C. yields only 14·76 per cent. of Pb O. The formula $2\,(C^{12}\,H^{21}\,O^{11})\,2\,Pb + 2\,(C^{12}\,H^{22}\,O^{11})$ supposes 14·2 per cent. of oxide of lead. Feronia gum repeatedly treated with fuming nitric acid, produces abundant crystals of mucic acid. Dried at 110° C. it

yields about 17 per cent. of water. The ash amounts to about 3·55 per cent. (*Pharmacographia*, p. 212.)

The pulp of the fruit contains citric acid and mucilage. If the pulp is thoroughly dried in a water bath and then covered with water for about five minutes, an almost pure solution of citric acid is obtained and recognised by the usual reagents; if left in contact with water for a longer period, the gum begins to enter into solution. The dried pulp contains 15 per cent. of citric acid, and a small quantity of deliquescent ash consisting of potassium, calcium and iron salts.

The leaves yield to distillation a small quantity of essential oil similar to that obtained from Bael leaves. (*See Ægle Marmelos.*)

Commerce.—The gum, or rather the mixed gums of which Feronia gum forms a part, is known as Ghati gum. In London these mixed gums are known as Amrads, and the term Ghati is applied to the gum of *Conocarpus latifolia*. The term Amrad is unknown in India, and appears to be of African origin, and to be applied to coloured Acacia gums.

SIMARUBEÆ.

BALANITES ROXBURGHII, *Planch.*

Fig.—*Wight Ic., t.* 274. Egyptian myrobalan (*Eng.*), Balanite Agihalad (*Fr.*).

Hab.—Drier parts of India, Egypt. The fruit.

Vernacular.—Hingan, Ingua, Hingol (*Hind.*), Hingon (*Beng.*), Nanjundan (*Tam.*), Gári, Ringri (*Tel.*), Hingana (*Mar.*), Hingoria (*Guz.*).

History, Uses, &c.—This plant is sacred to Isis, who is represented with a crown of it in her hand. In Egypt it was also a symbol of farewell and hope given to dying people. The seeds are found along with other fruit seeds in the Egyptian tombs.* The Greeks appear to have become acquainted

with the tree through the Egyptians, and it is mentioned by Hippocrates, Theophrastus, Strabo and Dioscorides under the name of Persea—περσέα. Dioscorides says that the dried leaves are applied to blood eruptions, and that the fruit is often infested by an insect celled κρανοκόλαπτον. Latin writers also notice the tree being sacred to Isis, and Pliny (15, 13,) says that Alexander gave orders that the victors should be crowned with it in the games which he instituted in honour of Perseus at Memphis. The fruit appears to have been occasionally confounded by the ancients with the Persica or peach, as it is sometimes described as edible. Baillon says that in Egypt the ripe fruit is called "desert date" and the unripe "Egyptian myrobalan." The African Arabs call the tree *El Heglyg*, and use the pulp as a detergent, and the bark to poison fish. In Senegambia the leaves are used as a vermifuge, and the roots and fruit as a purgative. (*Corre et Lejanne.*) In India Balanites is the Ingudi or Ingua of Sanskrit writers, who also call it Tápasa-taru and Munipádapa, "anchorite's tree," because the Gurus prepare from the seeds an oil for the lamp which they use in the ceremony of *Guru-upâsana*, or initiation of a Hindu by his spiritual guide. Another name for the fruit is Gauri-tvac, which seems to connect it with the worship of Gauri or Isani, the Indian goddess of abundance, the earth, the *sakti* or power of Isvara or Mahadeva, in whose honour bombs made with the shell are exploded. The festival of this goddess, called *Kâtyayanivrat*, is conducted by women at the vernal equinox; an interesting description of it under the name of the Gangore festival will be found in Tod's *Rajasthan* (Vol. I., p. 570). In all parts of India a boat is used as described by Herodotus in the Isis worship at Busiris, and by Tacitus in the Ertha worship among the Suevi in Germany. At the Ganpati festival in India, Gauri is worshipped in the form of a cornucopœia-shaped bouquet of leaves and flowers, and a similar emblem appertained to the Demeter or Ceres of the Greeks. Gauri also holds in her hand a Lotus flower as emblematic of reproduction. The leaves of Balanites are the Hingupatri of modern Sanskrit writers, but the true Hingu-

patri was doubtless the Asafœtida loaf. In the Concan and in other parts of India where this tree is unknown, the oil for the Guru-upásana ceremony is obtained from *Terminalia Catappa*, a tree which is not a native of any part of India except perhaps the eastern borders of Bengal.

The unripe fruit of Balanites is found in the druggist's shops in many parts of India, and is used as a purgative and anthelmintic, the dose being half of the pulp of a single fruit; in smaller doses of from 2—20 grains it is expectorant. The bark, unripe fruit, and leaves are given to cattle as an anthelmintic. The physiological action of the bark and fruit is similar to that of the genus Polygala, and a few drops of a tincture of the fruit is as efficient an emulsifier as Tincture of Senega. The kernel yields a bland fatty yellow tasteless oil, which is applied to burns and sores.

Description.—The fruit is an ovoid drupe, about two inches long, by 1½ inch broad, having a nearly smooth, fragile epicarp, marked by ten shallow longitudinal grooves; the greenish soapy mesocarp is traversed by numerous bundles of vascular fibres, and is adherent to the pentagonal, thick, woody shell. The descending seed contains under its coats a thick ex-albuminous embryo, with plano-convex cotyledons sometimes unequal, bilobed or corrugate, and a short superior radicle. As found in the shops, the fruit presents a wrinkled appearance, and is of a greenish-yellow colour, having been gathered a little before maturity.

Chemical composition.—The bark yields a principle similar to, if not identical with saponin. (*See* Saponaria.) The oil (*Zachun oil* of Africa) has a sp. gr. of ·9185 at 15·5° C., and congeals at zero. It yields 94·4 per cent. of crystallized fatty acids melting at 31°, and with a mean combining weight of 277. Sulphuric acid produces a brown colour not altered by stirring. With Massie's nitric acid test the oil becomes opaque, and is only slightly darkened in tint; the lower part of the oil becomes white and solid with a green ring where it touches the acid. Heated with a third of its weight of nitric acid, it changes.

to a light orange liquid, and when left to cool becomes solid in a few hours. It is a slow drying oil, and is readily bleached in sunlight. There are some points of resemblance between it and that of *Arachis hypogæa*. The seeds yield to solvents a little more than 50 per cent.

The pulp of the fruit contains organic acids 1·8 per cent., saponin 1·32 per cent., besides mucilage and sugar.

PICRASMA QUASSIOIDES, *Benn.*

Hab.—Sub-tropical Himalaya, South China. The wood and bark.

Vernacular.—Kashshung (*Hind.*).

History, Uses, &c.—A small tree or large bush with unequally pinnate leaves, and the aspect and foliage of Ailantus; it bears axillary stalked cymes of small diœcious or polygamous flowers, which have the calyx four or five parted. The fruit is a pea-like red drupe and is edible. Royle first drew attention to the bark and wood as being quite as bitter as quassia, and Stewart states that the leaves are used in the Punjab to cure scabies and the wood to kill insects. The bark has been recommended by Macardieu as a febrifuge, and under the name of *Brucea* (*Nima*) *quassioides*, the plant is noticed as a likely substitute for quassia in the Indian Pharmacopœia. In this work the bark is said to be sold under the name of *Bharangi* in Bengal, but this we are unable to confirm, as several samples of bharangi which we have obtained in Bengal and elsewhere all proved to be the roots and stems of *Clerodendron serratum.*

Description.—The wood consists of pieces of the larger branches from 3 to 6 inches in diameter, and is covered with a dark-brown bark, which has a somewhat netted surface, and is marked by transverse scars. On rubbing off the outer layer of suber an olive-green surface is exposed. The bark from a stem of 3 inches in diameter was ⅛ inch thick and very

compact. The wood and bark are of a light yellow colour; in the former a transverse section shows numerous fine, close, medullary rays, which intersect well marked, irregular, concentric rings. The centre of the stem is occupied by a cylinder of pith—in short, in appearance and taste the drug bears a close resemblance to quassia.

Under the microscope a transverse section of the bark exhibits an outer layer of brown suber, within which are two or three rows of empty transparent cells, followed by 8 to 10 rows of cells containing chlorophyll; these are succeeded by the liber tissue, which is divided into layers by about six rows of yellow stone cells. Lastly comes the cambium layer.

The medullary rays consist of about 15 vertical layers of cells; the single layers contain from one to five rows of cells. The tissue of the bark contains resinous deposits and crystals of oxalate of lime, which are so numerous towards the exterior portion that they produce opaque patches, visible to the naked eye.

The wood so closely agrees with the microscopic description of quassia by Pockington (*Pharm. Jn.* (3) *V.*, 321, *Year-Book*, 1875, p. 190), that we think it unnecessary to reproduce the particulars.

Chemical examination.—Our experiments indicate that the wood contains a crystallizable principle, probably quassiin, a fluorescing, bitter, resin-like principle, and at least one other non-crystallizable, bitter, resinous body, probably the uncrystallizable quassiin of Adrin and Mordeaux. There are several points of interest connected with the examination of *P. quassioides* to which we would refer. Firstly, the wood is not so bitter to the taste as ordinary quassia wood. Secondly, the authors of the *Pharmacographia* state that they obtained 7·8 per cent. of ash from quassia wood dried at 100° C.; the ash of *P. quassioides* obtained by us amounted to only 1·7 per cent. Thirdly, a watery solution of ordinary quassia wood is stated to display a slight fluorescence, especially if a little caustic lime has been added. According to Flückiger and

Hanbury this is apparently due to quassiin. We have repeated the experiment with a sample of ordinary quassia wood with negative results. The *P. quassioides* wood when treated with water or alcohol affords solutions which display a very marked greenish fluorescence. Regarding the content of quassiin it appears to vary considerably. A. Christensen (*Archiv. der Pharm.* (3) XX., 481,) states that he found the amount to vary greatly, some specimens yielding scarcely any. Stillé and Maisch give the yield at 0·15 to 0·05 per cent. (*National Dispensatory*) The authors of the *Pharmacographia* at about 0·1 per cent. MM. Adrin and Mordeaux—(*Repert. der Pharm.* XI., 246—50) obtained 0·125 to 0·15 per cent. of white crystalline quassiin. Oliveri and Denars (*Gazetta Chim. Ital.* XIX., 1—9) obtained only 0·03 per cent. of the pure principle. While Goldschmiedt and Weidel in 1877 failed to isolate quassiin, they obtained however a yellow resin, the presence of which had been previously noticed in the wood by Flückiger and Hanbury. The amount of crystallizable principle present in the wood we examined, we are unable to accurately give; as a rough approximation we do not consider that it would amount to more than ·02 to ·03 per cent. as an outside limit.

Regarding the methods of analysis, extraction of the wood by alcohol, and subsequent boiling of the dry alcoholic extract with water, concentrating, and precipitating with tannin, appears to give the best results, as far as a crystalline product is concerned.

In order to ascertain whether any of the Jaborandi alkaloids were present in the wood or not, we made the following experiments:—An alcoholic extract of the wood was digested with water acidulated with one per cent. hydrochloric acid, the solution filtered from insoluble resinous matter, and evaporated to a small bulk. When cold the deep yellow solution was precipitated with phosphomolybdic acid, filtered, and the precipitate washed with water containing a trace of hydrochloric acid. The precipitate was then treated with

baryta water, the excess of barium removed by CO^2, and the liquid with precipitate evaporated to dryness. The residue was then boiled with 96 per cent. alcohol. On evaporating off the alcohol a yellow non-crystalline varnish-like residue was left. This residue was bitter, partly soluble in water, and responded to the usual alkaloidal re-agents. The amount obtained did not exceed a trace.

The method of extraction above described was subsequently modified in the following manner:—

An alcoholic extract obtained from 263 grams of the wood was digested at a gentle heat for some hours with water acidulated with 2 per cent. of hydrochloric acid. The deep yellow solution was filtered, rendered alkaline with ammonia, and agitated with chloroform. The separated chloroform was then agitated with dilute hydrochloric acid, the acid liquid decanted, made alkaline with ammonia, and again agitated with chloroform; and this operation was repeated a second time. Finally the chloroform was evaporated off, and left an amber-coloured non-crystalline, transparent varnish-like residue. In water this extract was only slightly soluble, but in water acidulated with a few drops of nitric acid, it was wholly soluble, with the exception of a few flakes. On spontaneous evaporation of the nitric acid solution a yellowish non-crystalline residue was obtained, not easily soluble in cold 96 per cent. alcohol, slightly soluble in cold water, and not wholly soluble in warm water. An aqueous solution was of a deep yellow colour and possessed the following properties: Taste distinctly pungent, very slightly bitter and acrid. With alkaloidal group re-agents very marked précipitates were obtained; with very dilute solution, however, phosphomolybdic acid was one of the few re-agents which afforded a reaction. Fröhde's re-agent gave no colour reaction in the cold or on heating. The physiological action of the principle was tried by the following experiments:—A solution containing ·0009 gram of the principle injected hypodermically below the skin of a frog produced no symptoms; a solution containing about ·002 of a

gram hypodermically injected below the skin of a cat's thigh yielded negative results; one of us swallowed a solution containing ·0036 of a gram without any symptoms whatever ensuing. A strong solution applied to a cat's eye caused no contraction of the pupil.

The amount of this principle separated from the wood, though we had operated on a fairly large amount, was insufficient for further experiments Our experiments indicate however the presence of a distinctly alkaloidal principle in the wood, in addition to the principles already referred to. As far as our experiments have gone there is no evidence to show that the alkaloidal principle is related to the Jaborandi alkaloids. We have also examined *P. nepalensis* for these alkaloids with a negative result. It however contains an alkaloid which does not appear to be identical with that found in *P. quassioides*.

AILANTUS EXCELSA, *Roxb.*

Fig.—*Roxb. Cor. Pl., t.* 23; *Wight, Ill.* *1., t.* 67.

Hab.—Behar, W. Peninsula. The bark and leaves

Vernacular.—Maharukh, Mahanimb, Arua (*Hind.*), Maharukh (*Mar.*), Peru-maram (*Tam.*), Pedda-mánu (*Tel.*), Doddamari (*Can.*), Motho-araduso (*Guz.*).

History, Uses, &c.—It appears probable that this is one of the trees to which Sanskrit writers have given the name of Mahanimba. Its bark and leaves are in great repute as a tonic in Southern India, especially in debility after childbirth. The juice of the leaves is usually administered in *khir* (a kind of rice milk), or the juice of the fresh bark is given with cocoanut milk and treacle, or with aromatics and honey; it is said to stop after-pains. Ainslie says that the bark has a pleasant and somewhat aromatic taste, and is prescribed by native practitioners in infusion in dyspeptic complaints to the extent of three ounces twice daily, but from his description of the bark, it appears probable that he refers to *A. malabarica*, which bears the same Tamil name, the bark of *A. excelsa* being

intensely bitter like Quassia. Dr. Wight mentions that in the Circars the bark is regarded as a powerful febrifuge, and as a tonic in cases of debility.

Description.—Bark light coloured, very thick and granular, externally hoary, rough from the presence of numerous longitudinal scabrous ridges; internal surface yellowish white and finely fibrous; when soaked in water it swells greatly, and becomes glutinous on the surface; odour when moist acrid and disagreeable; taste very bitter. The leaves are abruptly pinnated, tomentose when young, afterwards glabrous, leaflets 10—14 pair, 4—5 inches long, coarsely toothed at the base; taste bitter and somewhat aromatic

Microscopic structure.—Sections for the miscroscope show that a great portion of the bark consists of large stony cells collected together in groups. There also many conglomerate raphides.

Chemical composition.—Dr. N. Dáji has separated from the bark an acid principle which he has named *ailantic acid.* It is reddish-brown, very bitter, and forms a deliquescent mass of waxy consistence, very easily soluble in water, less so in alcohol and ether, and insoluble in chloroform and benzol. (*Pharm. Jn.* (3) I., 154.)

AILANTUS MALABARICA, *DC.*

Fig.—*Rheede Hort. Mal. vi., t.* 15.

Hab.—Western Peninsula, Ceylon.

Vernacular.—Ood (*Mar.*), Poru-maram (*Tam.*), Podda-manu (*Tel.*), Hem-mara (*Can.*).

History, Uses, &c.—This tree grows along the edge of the Ghauts on the Western Coast. It is the Pongelion of Rheede, who gives Sarala* as the Brahminic name. The resin is known as Baga-dhup in Canara, and in Travancore as

* सरल is the Sanskrit name for *Pinus longifolia* The resin of *A malabarica* appears to be regarded as a substitute for Pine resin in Southern India.

Matti-pal. The bark has a pleasant, astringent and slightly bitter taste, is given in cases of dyspepsia and dysentery, and is also considered a valuable tonic and febrifuge. Reduced to powder, mixed with milk and strained, the resin is given in small doses in dysentery and also in bronchitis, and is reputed to be an excellent remedy, chiefly owing to its balsamic properties. The fruit, triturated with mango, and mixed with rice, is reckoned useful in cases of ophthalmia, and the juice of the fresh bark in 1 oz. doses with an equal quantity of curds is said to be a valuable remedy in dysentery.

Description.—The resin attached to the bark which was collected for us in Canara was very nearly the colour of hock-bottle glass; it was hard, brittle and translucent, and mixed with portions of the corky outer bark of the tree; alcohol readily dissolved it, and on evaporation left it as a very viscous, transparent, light-brown semi-liquid, which did not solidify after many days' exposure to a steam heat; when burnt it gives out a fragrance; the perfume is, however, inferior to that of many other resins employed as incense. The fruit is purplish-brown, of the size of a large nutmeg, slightly 3-angled at the base, mucronate at the apex; it consists of a very thick woody nut, surrounded by an oily shrivelled pulp; within are three cells, each of which contains a sweet-tasted oily flat seed.

Commerce.—The resin as met with in commerce is dark brown or grey in colour, plastic and opaque. It appears to have been obtained by tapping the trees, and is usually very impure. Value, Rs. 24 per cwt.

SAMADERA INDICA, *Gärtn.*

Fig.—*Gärtn. Fruct. II., t.* 156; *Wight, Ill., t.* 68; *Rheede, Hort. Mal. vi., t.* 18.

Hab.—Western Peninsula, Ceylon. The bark.

Vernacular.—Niepa (*Tam.*), Karinghota (*Malabar*), Samadara (*Cing.*).

Description, Uses, &c.—A tree 30 to 35 feet high, the Karin Njoti of Rheede, who gives Lokhandi as the Brahminic name. It has large, alternate, oblong leaves, and long axillary or terminal peduncles, divided at the top into a small umbel, which becomes pendulous in fruit; the latter is oval, $1\frac{1}{2}$ by 1 inch, and is a dry, compressed, one-seeded drupe, with a narrow unilateral wing; its surface is coriaceous, smooth, or slightly reticulated, and of a brown colour. The seed is brown and curved. The bark (Niepa bark) and the seeds are very bitter; the former is used as a febrifuge on the Malabar Coast. The wood is bitter, of a pale yellow colour like quassia wood, and is prescribed with myrobalans in fever. Sandals made from the wood are supposed to keep off malaria and other diseases, probably from the fact of their protecting the feet and keeping them dry. The natives also extract an oil from the kernels, which is said to be a good application in rheumatism. The bruised leaves are externally applied in erysipelas, and the seeds are worn round the neck as a preventive of asthma and chest affections. (*Rheede.*) This drug may well be used as a substitute for quassia.

The bark from the smaller branches occurs in quills from half an inch to one inch in diameter, its external surface is minutely fissured in every direction, of a dark brown colour, with light coloured patches here and there caused by exfoliation of the suber. Beneath the suber, which can be easily separated, the bark is yellowish-white, and this colour extends through its substance to the inner surface. The bark has a short fibrous fracture and bitter taste like quassia. A transverse section magnified presents no peculiarity worthy of remark.

Chemical composition.—De Vrij (1872) expressed from the seeds 33 per cent. of a light-yellow bitter oil, which contains, according to Oudemans, 84 per cent. of olein and 16 per cent. of palmitin and stearin. The bitter principle, *samaderin*, was yellowish, and soluble in water and alcohol and amorphous; Tonningen (1858) had obtained it from the seed and bark in

white scales, which became yellow with nitric or hydrochloric acid, and violet red with sulphuric acid. Flückiger calls it *quassiin*. (*See Year-Book Pharm.*, 1886, p. 196.)

BURSERACEÆ.

BOSWELLIA.

Several species inhabiting Eastern Africa, near Cape Guardafui, Socotra and the Southern Coast of Arabia.

Fig.—*Bentl. and Trim.*, *t.* 58. Frankincense trees (*Eng.*), Arbres d'encens (*Fr.*).

Hab.—Arabia, Socotra, Africa. The gum resin. Olibanum.

Vernacular.—Olibanum, Kundur, Lubán (*Arab.*, *Hind.*), Visesh, Esesh (*Bomb.*), Parangi-shambirani (*Tam.*, *Tel.*).

History, Uses, &c.—For an account of the different species, Birdwood on the Genus Boswellia, with descriptions and figures of three new species [*Linn. Trans.* xxvii. (1871), 111,] and Balfour (*Trans. Roy. Soc. Edin.* Vol. xxxi.,) may be consulted; also the *Pharmacographia*; but the exact number of species cannot be determined until more perfect materials shall have been obtained. An interesting summary of the history of Olibanum in Europe will be found in the *Pharmacographia*. It is the θύος, λιβάνωτός and λίβανος of the Greeks and the Tus or Thus of the Romans.* The olibanum trade between Arabia and India probably dates from pre-historic times. In the Book of Genesis (B. C. 1700), Arab merchants are mentioned as bringing spices, resin and stacte upon their camels from Gilead to Egypt; as no spices are produced in Arabia these must have come from India across the

* Confer. Theoph. Hist. Plant. iv., 6, ix. 1, 2, 4. Dios. i., 72 Plin. 12. 30,. 31, 32. Lucr. 3. 328. From Pliny's account it appears that there was no female frankincense in his time.

Persian Gulf. Alexander, B. C. 325, found a vessel loaded with frankincense at the mouth of the Indus, and trading companies are mentioned in Yajnavalkya's Code, B. C. 300. The chief centres of trade on the Western Coast were Sopara, Sanjan, Chaul (Perimula), and Thana, where markets appear to have been held during the fair season for the sale of Indian and Chinese merchandise in exchange for that of the West. Trade suffered from the opposition of the Persians and Brahmins in the 6th century B. C., but recovered in the 2nd century B. C., when its course was still from Egypt to Berenike and Aden, round the Arabian Coast to Kurrachi, and *via* Broach to the Thana ports. On the Roman conquest of Egypt, B. C. 30, trade greatly increased by the same route, until in A. D. 47 Hippalus discovered the monsoons and the possibility of crossing direct to the Indian Coast. In Pliny's time the principal exports from India were sesamum, oil, sugar, spices, rice, nard, costus, pepper, lac and indigo, and the imports frankincense, gum, storax, and Yavan girls. (*Sakuntala.*) In A. D. 525, cloves and aloe and sandalwood came from Ceylon, which had then become the chief centre of trade in the East The trade between India and Egypt began to fall off about the close of the 3rd century, and by the 6th century it had almost entirely been transferred to the East African ports. Thana and its ports were still important marts from the 9th to the 13th century, as we learn from the accounts of El Biruni, Ibn Haukal and other Arabian travellers. (*Bombay Gazetteer*) Sanskrit writers speak of olibanum as Kundurú, and describe its use as an incense and as a local application to indolent swellings to promote suppuration. The Mahometan writers describe several kinds of Olibanum—1*st*, deep yellow tears, called Kundur Zakar, or Male Frankincense; 2*nd*, pale tears, called Kundur Unsa, or Female Frankincense; 3*rd*, Kundur Madahraj, artificial tears, made by shaking the moist exudation in a basket; 4*th*, Kishar Kundur or Kashfa, the bark or scurf of the tree coated with the exudation (*Dhup of Bombay market*); 5*th*, Dukak Kundur, or dust of Olibanum. The first kind is most esteemed. Mir Mohammad Husain says that Frankincense should burn readily, showing that

it is not mixed with gum Arabic; should not emit much smoke, showing its freedom from Juniper resin. Moreover, he remarks that a kind of Frankincense is said to be produced in India which has a reddish tinge (probably an allusion to the gum resin of *Boswellia serrata*).

Olibanum is considered by the Mahometans to be hot and dry, and to have dessicative, astringent and detergent properties. It is used internally and externally in much the same way as we use the products of the Pines and Firs. In 1868, Olibanum was made official in the Pharmacopœia of India, where it is recommended in chronic pulmonary affections, such as bronchorrhœa and chronic laryngitis, employed both internally and in the form of fumigation. In the same work an ointment has been introduced which is said to be a good stimulant application to carbuncles, ulcerations, boils, &c. A good imitation of commercial Burgundy Pitch may be made by incorporating melted olibanum with water in a steam bath; a sufficiently good quality for this purpose can be purchased for Rs. 12 per cwt. Allcock's porous plasters are said to be made of it.

Bombay is the centre of the Olibanum trade. The houses which deal in gums have agents in Arabia and Africa, who buy it up and forward it in a mixed condition. It passes through the Custom House as *Esesh* (a corruption of विशेष), and is next sorted into four or five different qualities. The first, consisting of all the large clean tears, is destined for the European market. The intermediate qualities and the last, which is only the dust and refuse, supply the Indian and China requirements. The Kishar Kundur or Kashfa of the Arabs forms a distinct article of commerce under the Indian name of *Dhup*. The method of collecting olibanum in Africa has been described by Cruttenden. (*Trans. Bomb. Geograph. Soc. VII.*, 1846, 121.) Carter in the same publication has described the collection of the drug in Southern Arabia. In both localities a simple incision in the tumid bark is made, and the product collected as soon as it becomes sufficiently hard. The collection is carried on from March to September in Africa, and

from May to December in Arabia. Balfour found several species of Boswellia growing on Socotra. Of these, *B Ameero* yields an olibanum which on examination by Prof. Dobbie and Dr. Henderson was found to have the same composition as Arabian olibanum. The stalactitic form of olibanum, called Lubân Meyeti, produced by *B. Frereana, Birdw.*, is occasionally met with in the Bombay market under the name of *Pandhri Esesh* or *Pandhri Lubân*; it differs from ordinary olibanum inasmuch as it contains no gum soluble in water.

Examination of some living cuttings of branches of **Boswellia Bhau-Dajiana**, *Birdwood, received from the Victoria Gardens, Bombay, by Mr. J. G. Prebble.*—On wounding the bark a milky fluid immediately exudes. This is faintly acid to litmus paper, and of an agreeable lemon odour and slightly bitter taste. Examination under the microscope shows the milky fluid to be a very fine emulsion of oil; by rubbing it between the cover glass and the slide, the globules of oil may be made to unite in larger drops. Two or three starch granules may be detected in a slide by the aid of the polariscope, but these are probably derived from the neighbouring starch cells and not from the secretory reservoirs. The emulsion is not coloured blue by iodine nor darkened by iron salts. A transverse section shows an outer layer of cork composed of thin-walled, compressed tangentially elongated cells of a yellow colour. It is this layer which is thrown off in thin dry, waxy-looking papery sheets, and hanging loosely about the stem is continually renewed from beneath. Next to the cork is a layer of parenchymatous cells mostly filled with a reddish brown colouring matter associated with tannin. This colouring matter is very little affected by the usual solvents. It is darkened in colour but not removed by solution of potash, but is readily soluble in acetic acid.*

* Professor J. L. de Lanessan found in the bark of the allied species *Boswellia papyrifera* "une matière colorante rougeâtre insoluble dans l'ammoniaque froid et bouillant, dans une solution bouillante faible d'acide sulphurique, dans l'alcöol et l'éther bouillants, légèrement soluble dans l'acide acétique bouillant."—(*Histoire des Drogues, tome* 1—268.)

Cells containing plenorhombic crystals of calcium oxalate are very numerous next the corky layer. Further within the bark are cells containing small oval or oblong starch grains giving a well defined cross with polarized light. The undulating medullary rays, composed of 2 or 3 rows of radially elongated cells, divide the liber into narrow wedges. The large, oval, intercellular secretory reservoirs which contain the milky fluid are mainly distributed in this layer in three or four interrupted and not very regular tangential rows. The lumen has an average measurement of 100 mkm., and is surrounded by two or three rows of secreting cells. A few secreting reservoirs occur in the outer bark, but they are not met with in the wood nor in the medulla.

Interspersed through the bark and sometimes forming an interrupted ring in the outer bark, are groups of refractive bast fibres. The wood is composed of narrow wedges of woody parenchyma containing numerous vessels. The medulla contains like the bark a reddish brown colouring matter blackened by iron salts. In longitudinal section the secretory reservoirs anastomise in a peculiar manner like the links in a chain, and the bast fibres frequently bifurcate. The medullary rays are composed of two or three rows of cells from six to twenty deep and not arranged in parallel rows.

According to the account of the Swiss traveller, G. A. Haggenmacher,* the bark is used by the Somalis for tanning. Assayed for tannin by Lowenthal's permanganate and gelatine process, and observing the details recommended by H. R. Proctor; 4·7 c. c. permanganate solution, 1 gramme per litre, was consumed by 20 c. c. of a decoction representing ·2 gramme of dry bark. Expressed in terms of oak bark using Oser's equivalent, these results give 4·7 per cent tannin extracted by boiling water.

Description.—Olibanum as found in commerce varies considerably in quality and appearance. It may be described as a dry gum-resin, consisting of detached tears up to an inch in

* Quoted by Flückiger, *Pharm. Journ.* [3] viii. 807.

length, of globular, pear-shaped, clavate, or stalactitic form, mixed with more or less irregular lumps of the same size. Some of the longer tears are slightly agglutinated, but most are distinct. The predominant forms are rounded,—angular fragments being less frequent, though the tears are not seldom fissured. Small pieces of the translucent brown papery bark are often found adhering to the flat pieces. The colour of the drug is pale yellowish or brownish, out the finer qualities consist of tears which are nearly colourless or have a greenish hue. The smallest grains only are transparent, the rest are translucent and somewhat milky, and not transparent even after the removal of the white dust with which they are always covered, but if heated to about 94° C., they become almost transparent. When broken they exhibit a rather dull and waxy surface. Examined under the polarizing microscope, no trace of crystallization is observable. Olibanum softens in the mouth; its taste is terebinthinous and slightly bitter, but by no means disagreeable. Its odour is pleasantly aromatic, but is only fully developed when the gum resin is exposed to an elevated temperature. At 100° C. the latter softens without actually fusing, and if the heat be further raised decomposition begins. (*Pharmacographia.*)

Chemical composition.—Flueckiger and Hanbury observe that cold water quickly changes olibanum into a soft whitish pulp, which when rubbed down in a mortar forms an emulsion. Immersed in spirit of wine, a tear of olibanum is not altered much in form, but it becomes of an almost pure opaque white. In the first case the water dissolves the gum, while in the second the alcohol removes the resin. They find that pure olibanum treated with spirit of wine leaves 27—35 per cent. of gum, the solution of which is precipitated by perchloride of iron as well as by silicate of sodium, but not by neutral acetate of lead. It is consequently a gum of the same class as gum Arabic, if not identical with it. Its solution contains the same amount of lime as gum Arabic affords. The resin of olibanum has been examined by Hlasiwetz (1867), according to whom it is a uniform substance having the composition $C^{20} H^{30} O^{3}$.

Flückiger and Hanbury find that it is not soluble in alkalis, nor have they succeeded in converting it into a crystalline body by the action of dilute alcohol. It is not uniformly distributed throughout the tears; if they are broken after having been acted upon by dilute alcohol, it now and then happens that a clear stratification is perceptible, showing a concentric arrangement. Olibanum contains from 5—7 per cent. of essential oil. According to Stenhouse it has a sp. gr. of 0·866, a boiling point of 179·4 C., and an odour resembling that of turpentine but more agreeable. Kurbatow separated this oil into two portions, one of which has the formula $C^{10} H^{16}$, boils at 158° C., and combines with HCl to form artificial camphor; the other contains oxygen.

Luban Meyeti, which is is considered by Flückiger and Hanbury as the *Oriental* or *African Elemi* of the older writers, and also one of the resins anciently designated *Animi*, has an agreeable odour of lemon and turpentine, and a mild terebinthinate taste. Treated with spirit of wine, ·898 of it is dissolved; the undissolved portion is not crystalline. Distilled with water it yields about 3 per cent. of a fragrant volatile oil having the odour of elemi, and a sp. gr. of ·856 at 16° C. The oil examined in a column 50 millim. long, deviates the ray 2°·5 to the left. It consists of a dextrogyre hydrocarbon, $C^{10}H^{16}$, mixed with an oxygenated oil, which is evidently levogyre, and exists in proportion more than sufficient to overcome the weak dextrogyre power of the hydrocarbon. No gum is present in this exudation. (*Pharmacographia*.)

Commerce.—Olibanum is shipped from Makulla, Aden, and other neighbouring ports to Bombay; as already mentioned, it is there sorted for the different markets. The trade is in the hands of Khojas and Banias. The price varies from Rs. 4 per cwt. for the dust to Rs. 20 per cwt. for the finest tears. Bombay exports from 25,000 to 30,000 cwts. annually. Nearly four-fifths of this quantity go to Europe, and the rest to China.

BOSWELLIA SERRATA, *Roxb.*

Fig.—*Colebr. in Asiat. Res. IX., 379, t. 5.* Salai tree (*Eng.*).

Hab.—W. Himalaya, Central India. The gum-resin.

Vernacular:—(The gum-resin) Salai, Gúgal (*Hind.*), Gugar (*Guz.*). In Southern India it bears the same names as olibanum.

History, Uses, &c.—The history of this drug is involved in much obscurity, owing to it shaving been confounded by both native and European writers with true Frankincense and Bdellium. Sanskrit writers may possibly sometimes allude to it when they speak of Kunduru, but as this word is evidently the same as the Arabic Kundur, it is much more likely that they allude to the true Frankincense imported from Africa and Arabia, and which we know to have been introduced into India at a very remote period. Mahometan writers have probably included the produce of *B. serrata* among the different kinds of Mukul for which they give as the Indian synonym Gúggul. It seems probable that the true Sanskrit name for *B. serrata* is Sallaki, from which the Hindí word Salai has been derived. The exudation from the tree is called Sallaki-drava or Sihla, and Guggulu. Ainslie notices *B. glabra* as producing Gúggul, and *B. serrata* the olibanum of commerce, but calls the latter *Salai*, and quotes Dr. F. Hamilton's MS. account of Shahabad, where the tree is said to be very common and to yield a resin called *Sale-gond* or *Sale-lassa, which is not used.* Dr. Hamilton describes it as of the consistence of turpentine when it flows from the tree; in this state it is called at Chandalghar Gandah-biroza, and in the dry state Sukha-biroza. (*Mat. Ind.* 1, 226.) Other European authors make the same mistake with regard to the source of commercial olibanum. *B. glabra* is now considered to be only a variety of *B. serrata*. *B. serrata* is one of the commonest trees in some parts of Khandesh, Loonawara, and other neighbouring territories; the gum-resin is obtained by incising the bark. Dr. Hooker, when ascending from Belouppee in Behar to the height of 1,360 feet, came upon a

small forest of these trees, which he likens to the mountain ash. Dr. Irvine remarks that the tree is very plentiful in the Ajmeer hills, where the gum-resin is called Ganda-biroza, and is similar in appearance to Venice turpentine. Dr. O'Shaughnessy obtained fine specimens from the Shahabad country. The collection of Gúggul is a source of revenue to the Bhils, and a stake cut from the tree is set in the ground when a marriage takes place among them. Sanskrit writers describe Gugguln as moist, viscid, fragrant, and of a golden colour when freshly exuded—a description which is not applicable to the exudation of the Balsamodendrons, but is exactly so to the exudation of *B. serrata*. It is said to be demulcent, aperient, alterative, and a purifier of the blood. The Yogarája gúggula is a well known alterative compound; it contains Guggal 25 parts, Triphala 15 parts, ginger, long pepper, chavak, pipalimal, chitrak, hing, ajmod, siras, jira, shahjira, renuka, indrajao, paharmul, baberang, kutki, atis, bharjngi, vekhand, of each one part, morvel two parts. The whole is made into a pill mass, the dose of which is from 3 to 5 grains, to be taken with a decoction of *Sphæranthus indicus*. It is used in rheumatism, nervous diseases, scrofulous affections, urinary disorders and skin diseases, and is generally combined with aromatics.

Description.—The fresh exudation has the colour and consistence of Canada Balsam; it hardens very slowly, retaining its golden colour and transparency. The odour is that of olibanum, but fainter and more terebinthinate; cold water converts it into a soft whitish pulp, which, when rubbed in a mortar, forms an emulsion. Spirit also makes it white and opaque by dissolving the resin. In short, it has the characters of olibanum, but does not harden like that article. It burns readily, and diffuses an agreeable odour.

Commerce.—Gúggal is not exported from India, but is consumed in Central and Northern India as an incense and medicine.

A large quantity is collected in the Satpoora forests, where it is sold on the spot at 12 lbs. for a rupee.

BALSAMODENDRON, *Sp. nov.*

Fig.—*Bentl. and Trim., t.* 60.

Hab.—Africa, Socotra, Arabia. Myrrh.

Vernacular.—Ból (*Hind., Beng., Guz.*), Vellaip-polam (*Tam.*), Bálimtra-polam (*Tel.*), Bolá (*Can.*), Bálata-bola (*Mar.*).

History, Uses, &c.—Myrrh was known to the ancient Egyptians, Professor Dümichen has discovered an inscription at Deir el Bahari which records an expedition to the balsam land of *Punt* (the modern Somali country), undertaken by Hatasu, a queen of the XVIIIth dynasty, who lived about 1700 years B. C. Through this expedition, we learn from the inscriptions, "thirty-one verdant myrrh trees" were introduced into Egypt, besides a large quantity of myrrh. In a drawing on the walls of Hatasu's temple at Deir el Bahari there is a represntation of myrrh trees planted in wooden tubs and heaps of myrrh, which are recorded as having been "brought over the ocean to Egypt." The inscriptions which refer to these trees give very exactly the place from whence they came. They were, we are told, "brought over the sea in ships from the incense mountains of the Somali country." These mountains, we are further told, formed the "best district of the incense-land." In another drawing on the Deir el Bahari monument, may be seen a figure of one of these trees. It represents a medium size tree with somewhat thick trunk and spreading branches. The leaves are oval, and appear to terminate in an acute point. There is also shown, exuding from the stem in the form of tears, a gum-resin, which in the original is coloured red. Myrrh was also imported into Egypt from Socotra. An inscription on the walls of Thothmes III.'s temple at Karnak, erected about 1600 B. C., records an expedition undertaken by that king to this island, for the purpose, it is related, of introducing "all the beautiful plants of that country." Many of the plants are figured on the walls of the Karnak temple, and among them is undoubtedly one which represents the myrrh tree. Myrrh was also imported from Arabia, as is shown from a sentence in the Papyrus